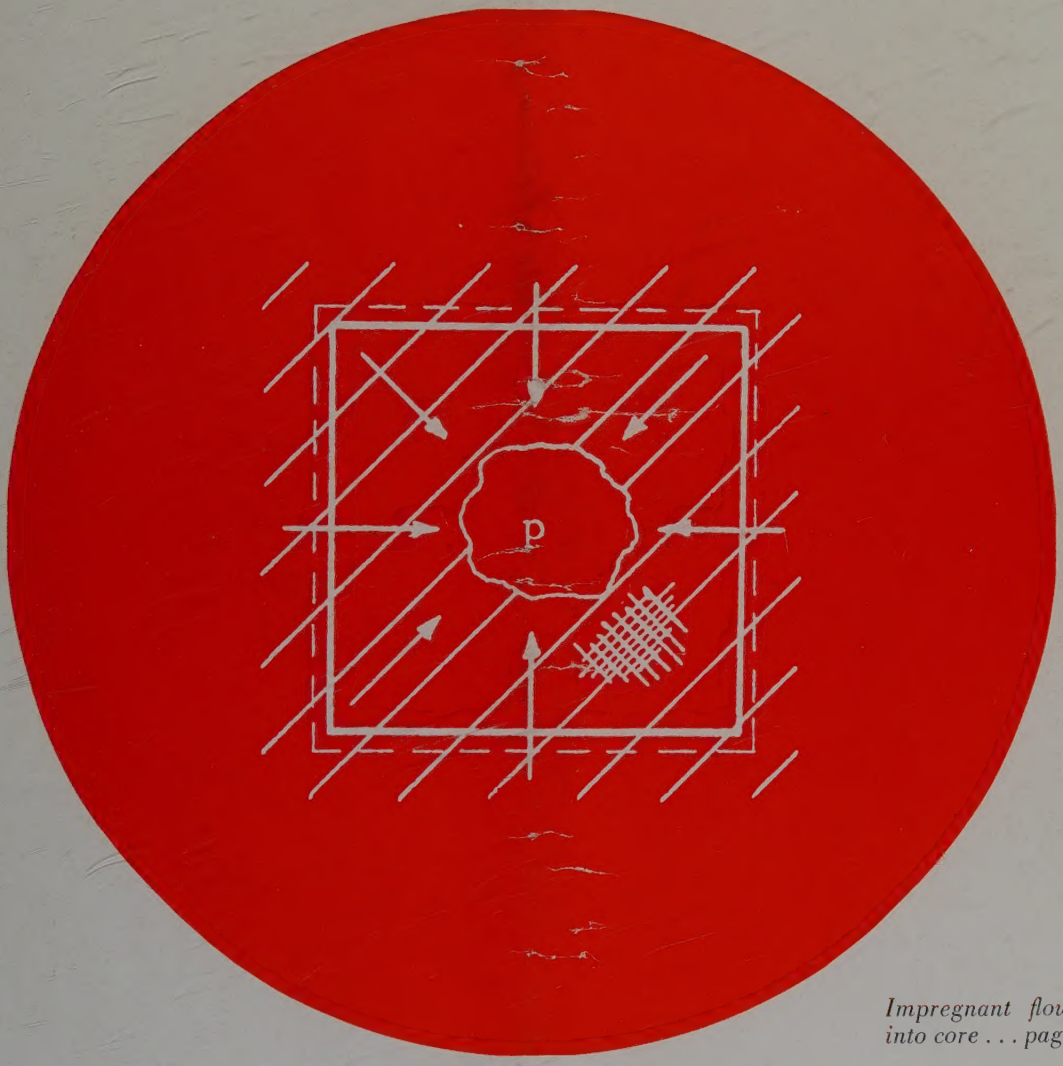
December 1961

# Insulation




*Impregnant flowing into core . . . page 33*

TEFLON* INSULATING MATERIALS—pressure sensitive and non-pressure sensitive tapes, spaghetti and large size flexible tubing, Hi-VPM film . . . for tough, temperature-stable Class H service.

*Du Pont Trademark

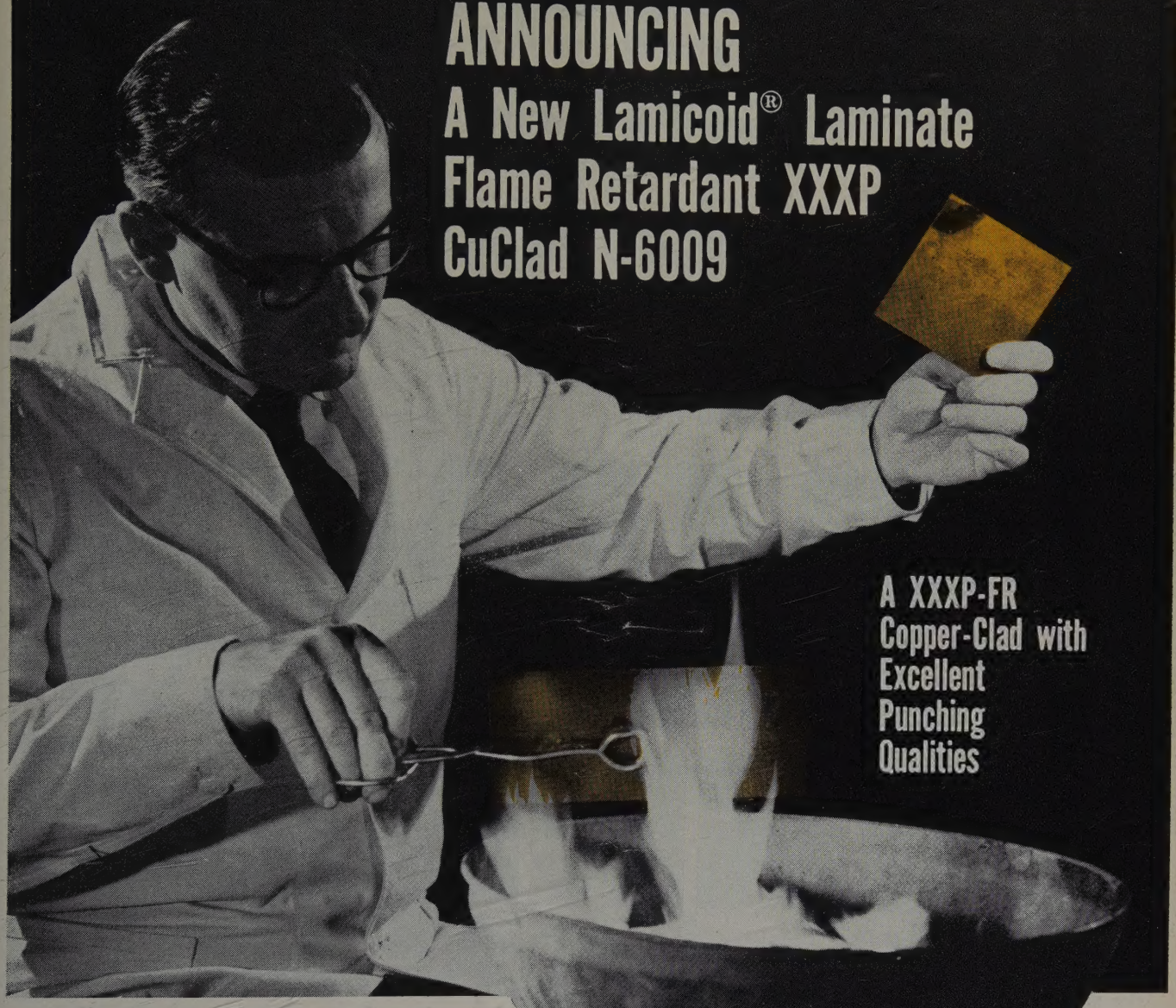
# PERMACEL®

NEW BRUNSWICK, NEW JERSEY • TAPES • ELECTRICAL INSULATING MATERIALS • ADHESIVES

WHERE RESEARCH IS THE KEY TO TOMORROW

3M COMPANY

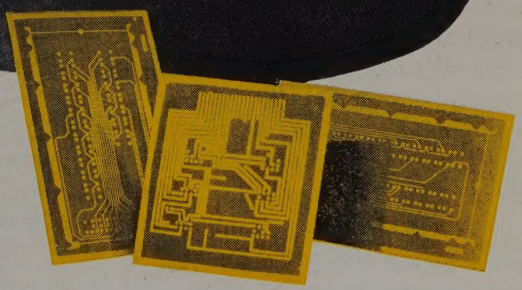
# ANNOUNCING
## A New Lamicoid® Laminate
## Flame Retardant XXXP
## CuClad N-6009



**A XXXP-FR Copper-Clad with Excellent Punching Qualities**

MICO's newest copper-clad laminate provides you with a non-brittle, dimensionally stable printed circuit board that:

*improves product performance* due to high electrical properties, low cold flow, low water absorption, high peel strength and dimensional stability; *reduces processing rejections* because of its consistency from lot to lot; *is flame retardant* — extinguishes in 3 seconds; *is readily fabricated* — good punching at 70 F, excellent at 120 F.



CUCLAD N-6009 is available with 1- or 2-ounce copper one or two sides (or without copper if you want an excellent XXXP-FR laminate only.)

COMPLETE DATA on CUCLAD N-6009 laminates will be sent you immediately on request. Contact your nearest 3M sales office or send your inquiry here and see how N-6009 can solve your printed circuit punching problems.

MICO ELECTRICAL INSULATION

**MICA INSULATOR**

DIVISION OF MINNESOTA MINING & MFG. CO.

**SCHENECTADY 1, NEW YORK**

MICANITE® AND ISOMICA® PRODUCTS LAMICOID® LAMINATES & FABRICATED PARTS SILICONE & TFE COATED CLOTHS & TAPES

***Print Ins. 52 on Reader Service Card***

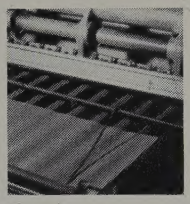
***Print Ins. 51 on Reader Service Card***

# dependable electrical insulation parts spell

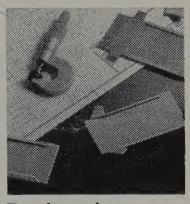
# INMANCO

Forming

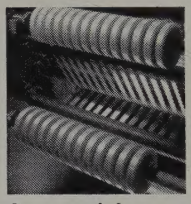
Shearing and Sawing



Sheeting



Engineering Service



Commercial Slitting

Punching

Cuffing and Crimping

The name INMANCO is backed by over 25 years of experience in the manufacturing and fabricating of precision products for the electrical and electronic industries from nationally-recognized brands of highest quality electrical insulating materials.

For example, Inmanco's fabricated insulators assure accuracy . . . guarantee uniformity. Modern, high-speed equipment is designed to *shear, slit, die-cut, crease, mill, form,* or *cuff* exactly to specifications. Your costly assembly time is cut to a minimum.

Exact properties and materials required for any specific application are yours from Inmanco. Inmanco engineering and technical know-how permit you to select electrical insulation parts with extreme heat resistance, top dielectric strength, desired degree of flexibility, toughness or other protective features.

This same high-level engineering knowledge is available to you, through Inmanco, for jobs that other fabricators can't or won't do. Call on Inmanco for full information and assistance.

Contact your nearest Inmanco representative and write for free catalog and brochures.

**Inmanco®**
**INCORPORATED**
**PRECISION MADE ELECTRICAL INSULATION PRODUCTS**

Dept. IM, 571 W. Washington Blvd., Chicago 6, Illinois
Representatives and Distributors in Principal Cities

**Print Ins. 53 on Reader Service Card**

# Insulation

*For the Electrical and Electronic Industries*

*Lake Publishing Corporation, 311 East Park Avenue, Libertyville, Illinois, December, 1961*
*Publishers of Insulation, Insulation Directory/Encyclopedia Issue, Plastics Design & Processing*







*Circulation Policy and Subscriptions: Insulation* is distributed without charge within the United States to qualified users of electrical and electronic insulating materials engaged in design and specifying work covering the use of insulation. Subscription rates to others within the United States, Canada, and U.S. Possessions are $1.25 per copy, $12.50 per year, and $20.00 for two years. Rates for other countries are $25.00 per year, $45.00 for two years. Circulation requests and inquiries should give title or department, company name, and products or services of company. Corrections should also show old company name and address.
*Back Issues,* when available, are charged for at the rate of $1.50 per copy for 1 to 10 copies and $1.25 per copy for 10 or more copies for requests from within the United States, Canada, and U.S. Possessions; $2.50 per copy to all other countries.



*Insulation,* December, 1961, Volume 7, Number 13. Published monthly, except twice a month in May, by Lake Publishing Corp., Box 270, 311 E. Park Ave., Libertyville, Ill. Phone EMpire 2-8711. Accepted as controlled circulation publication at Mount Morris, Illinois.

BPA Member Business Publications Audit of Circulation, Inc.



*Advertising Sales Offices: See page 84.*

# *From the Editor*

## *Opinions and Rambling Thoughts*

***How to Succeed in Business Without Getting Off Your Duff***

There's much to be said for thoroughly lab testing and field testing new materials and products before putting them on the commercial firing line. We heartily endorse the practice. But we sometimes wonder how many products never get into the market place just because somewhere an engineer is playing it 100% safe by sitting on his duff . . . by sitting on information that could pretty well determine the potential success or failure of a new product.

Let's put it this way. When a product is still in the developmental and evaluation stages, the scientists and engineers are complete masters of the situation. Management officials, plant superintendents, and sales managers have absolutely no control over such products because they either don't know about them or because they can't touch the products until the engineers and scientists say the products have passed all tests and are ready.

Now, it isn't unreasonable to assume that at times the introduction of a new product is delayed strictly because unconsciously a laboratory official dislikes to give up his complete life or death control over a product. But I don't think this is the case too often.

Instead, I think that more frequently there is an engineer on the project who always wants to play it 100% safe by running another series of tests, and another, and another, and so on. Or else he wants to think about the data more. Or his report is never quite complete. Or he is seeking additional information from other sources.

What do we mean when we say such an engineer is playing it 100% safe? We don't mean that the additional time he demands will permit a safer, more accurate appraisal of the product. But we do mean that the man who never makes a decision can always feel that he has never made a wrong decision. And in the process of delaying decisions he can feel quite important since all those who have some knowledge of the project will wait with bated breath for words of wisdom from the temporary great white father. Unfortunately, management is even misled in a few instances by such tactics and they promote the man into an even bigger stumbling block.

It's never happened in firms with which you are familiar, you say? Are you sure? Do you know of any tests being run which are merely reinforcing the results of tests which were previously made to reinforce the results of the original tests? Do you know of anyone who has an excuse every time he is asked to write a detailed report, technical paper, or article on a new development? Do you know of someone who won't release or approve information for marketing or advertising because he thinks further evaluation or checking is in order before claims can be made? Do you know of anyone who is just plain lazy . . . who, when it is finally necessary, provides management with insufficient information so that someone else's neck will be stuck out or who gives page after page of detailed information without interpreting its significance?

It is true that you can find such situations in any type of company and type of work. But we are not now concerned with other types of companies or types of work. Is there someone you know who is succeeding in blocking progress by sitting on his duff?

***. . . naut***

Ever since the boys got themselves rocketed into the wild blue yonder we have noticed an increasing number of products and jobs which carry a "naut" appendage at the end of the word. For example, Reynolds Metals Co. has just participated in describing a new aluminum research submarine as the Aluminaut. The end of this fad might see *Insulationaut* delivered to you by postmanaut.

***What Is Meant?***

A friend has brought to our attention a problem which we have commented on in the past but which is important enough to be periodically reemphasized. It is simply this—there are too many comparisons of the properties of competitive materials which are not valid comparisons. Actual working values under identical test conditions are valid. But too many comparisons are on the basis of minimum standards or specifications values versus actual working values. This can easily make one product look good and another bad. The answer to this problem lies with everyone who prepares comparative test data . . . let's make sure it is realistic.

***And Last . . .***

. . . but not least, everyone from *Insulation* and Lake Publishing Corporation wishes you a most joyous Christmas. Joyous is a much better word than merry to our mind . . . it includes not only the happiness that comes from giving and receiving material things, but also the true joy and blessings that are ours when we comprehend the real meaning of Christmas.

## AIEE and IRE to Consider Merger

For years those who were not members of the inner circles of the American Institute of Electrical Engineers and Institute of Radio Engineers have wondered why the two societies did not join forces since their interest duplicate each other in so many areas . . . now comes word that the Boards of Directors of both groups have passed resolutions for the formation of committees to determine the feasibility and form of such a consolidation.

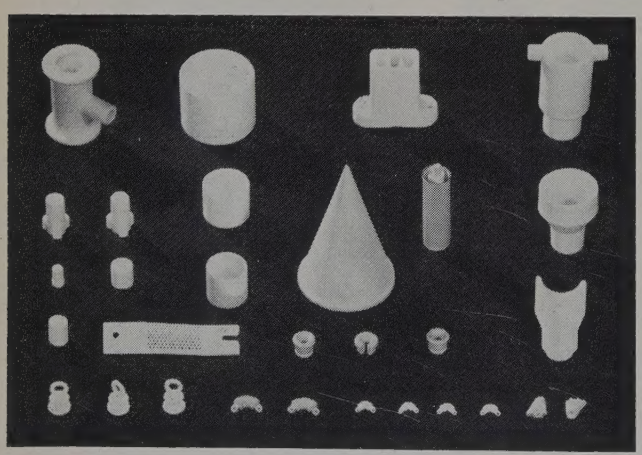
The proposed new international organization would involve some 150,000 engineers, scientists, educators, and industrialists. The joint committee is to submit a report to the boards of both societies no later than February 15, 1962, for their approval, with a view to submission to a vote of the memberships of the two associations and consummation, if so approved, by January 1, 1963. The committee was also authorized to prepare a proposed constitution and bylaws. The blue ribbon committee includes various present and past officers and directors of both groups.

AIEE was organized in 1884 and has about 70,000 members from the United States and Canada. IRE, organized in 1912, has a membership of 91,000 and is international in scope. Only about 6,000 members now belong to both societies. Headquarters for both are in New York City.

## Injection Molded Ceramics

By using an injection molding process, high-speed, semi-automated production of intricate ceramic shapes is now possible according to American Lava Corp., Chattanooga, Tenn. Insulators, appliance parts, electronic components, radomes, dielectrics, and other parts are some of the designs which are being injection molded. The process reportedly helps to reduce costs by faster production and provides a means of fabricating more complicated shapes from ceramic materials than was previously possible.

As in the past, firing of the fabricated parts is still necessary. However, many common ceramic shapes which were previously pressed or extruded and machined at one-at-a-time rates, can now be produced in multiples in one-shot injection molding operations. The economics of the new operation may also make it practical to produce parts which in the past were not financially feasible. In addition, it is claimed that the parts produced by injection molding are more identical in shape and size since they come from the same mold—a matched condition which is not possible with machining. The firm states that more than a dozen ceramic compositions can be injection molded including aluminas, titanium dioxide, forsterite, zircon, spinel, barium titanates, and others.



## Thermally Stable Modified Kraft

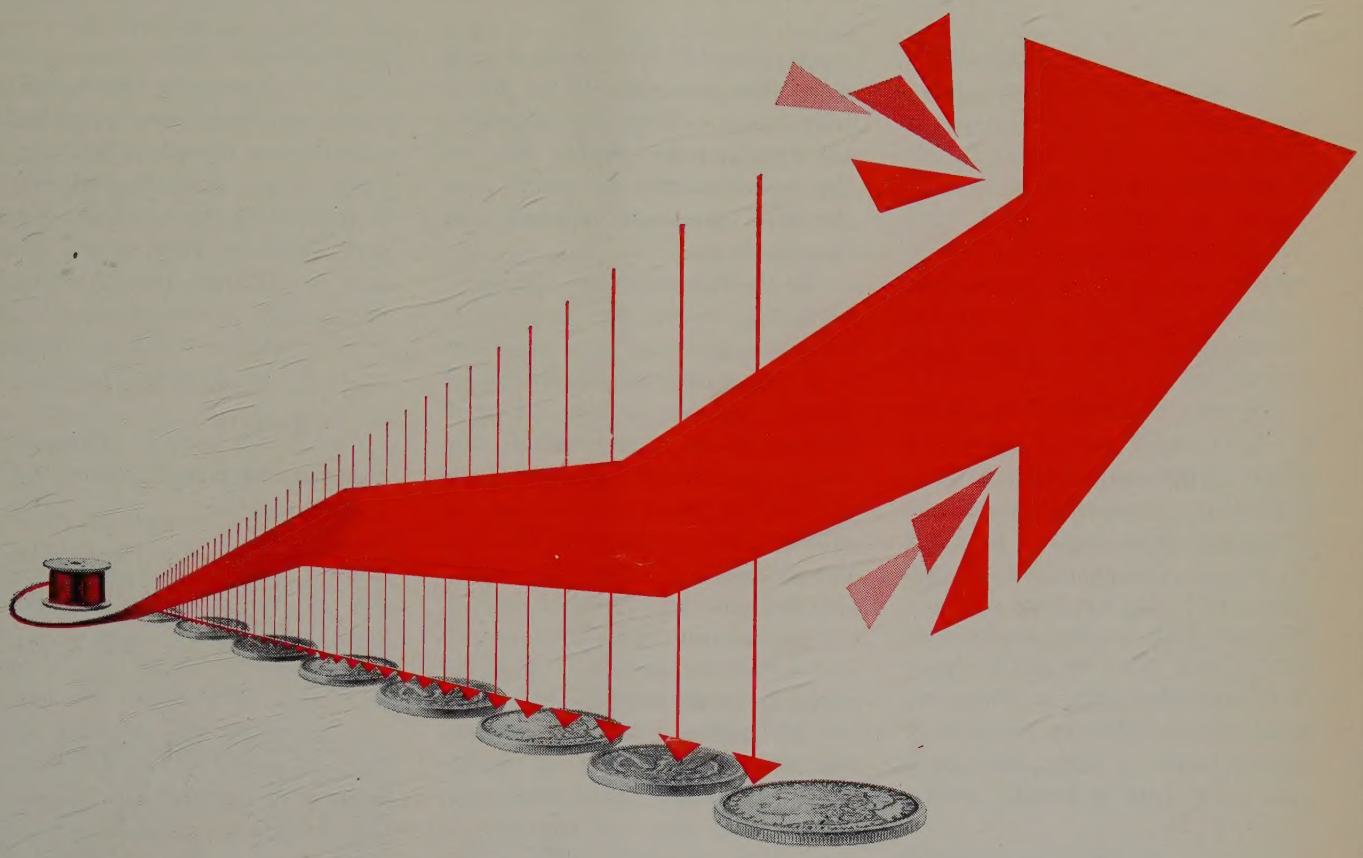
A new modified kraft insulation which provides improved thermal stability has been developed by the Thomas A. Edison Research Laboratory division of the McGraw-Edison Co. Said to make possible higher temperature operation and reduced size of transformers as well as extended life expectancy for products using the new insulation, the modified kraft is produced on commercial paper-making equipment in the form of tape, paper, and

board. Photo shows visual evidence of breakdown of electrical grade kraft after accelerated aging in contrast with new Edison modified kraft. Aging involved immersion in oil at 150°C for extended periods.

## Plastics News

It's rare that a month goes by without news about new or increased production of polyolefins. Latest is the word from Eastman Kodak in regard to plans for a 50 percent increase in polypropylene production. The unit will be added to the present plant at Longview, Texas and will add a capacity of 10-million pounds annually to the present 20-million pounds.

Marbon Chemical Division of Borg-Warner Corp. has just reduced the price of their ABS plastic some 10 to 14 percent in truckload quantities. Natural grades now sell at 42¢ per lb and standard and custom colors at 46¢ per lb.



# Phelps Dodge POLY-Thermaleze® sales go up as users' costs go down!

**Standardizing with Poly-Thermaleze* means reduction of your costs because this film wire upgrades all grades and permits, in most cases, interchangeability of grades as well as reduced inventories.**

**This *one* versatile wire matches with PLUS values—in practically all respects—the properties of Class A, B and F rated film wires.**

***Here are the PLUS values:***

**1.** HIGH TEMPERATURE CUT THROUGH—giving physical-thermal protection between turns in service.

**2.** CLASS "A" through CLASS "F plus"—no heat shock.

**3.** COMPATIBILITY—the highest order of compatibility with conventional varnishes including epoxy encapsulated systems.

**4.** OUTSTANDING SOLVENT RESISTANCE—remarkable resistance to conventional varnish solvents.

**5.** HIGH DIELECTRIC STRENGTH—highest volts/mil of any wire available.

**6.** EXCELLENT WET DIELECTRIC STRENGTH—best retention of electrical properties under extreme water conditions.

**7.** HERMETICS—now performance proved in Refrigerant 12 and 22.

**8.** WINDABILITY—extreme flexibility and toughness.

Experience has already proved that equipment using Poly-Thermaleze "lives longer" at normal operating temperatures.

To obtain the PLUS values of Poly-Thermaleze, do not accept substitutes. Poly-Thermaleze was developed by Phelps Dodge and is made only by Phelps Dodge and its licensees**.

*Poly-Thermaleze®—Patents applied for.

**Licensees: Essex Wire Corporation, General Cable Corporation, Rea Magnet Wire Company, Inc., Div. of Aluminum Company of America.

Magnet Wires that Pace the Industry!

**PHELPS DODGE COPPER PRODUCTS** CORPORATION

**INCA MANUFACTURING DIVISION**

FORT WAYNE, INDIANA

MINE TO MARKET

***Print Ins. 55 on Reader Service Card***

# *Letters to the Editor*

*Pasadena, Cal.*

"It was with great interest, that I read and digested the 'Evaluation of Water-Soluble Fluxes' report by Mr. F. Z. Keister in *Insulation* issues of August and September, 1961. I admired his elaboration on the subject, but the concluding sentences of his evaluation referring to cleaning and fluxing recommendations really disappointed me.

"My own experience with the use of water-soluble flux ('Alpha 201' which approximates Mr. Keister's Type 'G') prompt me to question his recommendations '—to use ultrasonics or several detergent and distilled water rinses. Do not apply excessive flux—spraying is a good way to avoid this —' and, 'allow the flux to dry or to be preheated prior to solder dipping.' These statements are misleading, or to put it mildy, *only partly correct* and have to be taken with a 'grain of salt.'

"Subjecting printed circuit boards with components attached like diodes, transistors, resistors, etc., to ultrasonic cleaning has to be considered dangerous and can result in broken 'cat whiskers' and vacuum-seals, if the frequency of the ultrasonic equipment is 'right.' Extensive component process specification tests are, therefore, a must in order to eliminate damage by ultrasonic vibration.

"I believe a process caution notation should have been added to the ultrasonic cleaning recommendation. Our tests with detergents resulted in eliminating the detergent solution completely because of the alkaline content of the detergents. pH test revealed an alkaline contamination with the use of detergents which is as objectionable as an acid contamination.

"*Tap water flush* with a *final distilled water rinse* results in a practically neutral board. The flux starts to remove oxides prior to exposure to heat, and becomes very active at temperatures above 250°F. At 400°F it is decomposed, leaving an inert, inactive residue. This residue is completely soluble in water and may be removed readily by washing immediately after soldering. If the flux is overheated, it may char, leaving a black carbonaceous residue. This residue is not soluble in water. It is, therefore, important to avoid overheating the flux.

"As to the '*spraying, drying* or *preheating*' of the flux prior to the soldering operation, our experience with flux application reveals the following: Spraying and/or drying or heating of the water soluble flux results in crystal formation and glutamatic-acid-concentration as the diluting water evaporates. This creates problems with the solder operation and with the removal of residues.

"Dipping the surfaces to be soldered into flux and then tilting the surfaces slightly to let the excess flux run off has been proven the optimum method. The elimination of possible heat shock damage to the components while passing from ambient temperature of approximately 72°F to the flow or dip solder temperature area may require a preheating operation.

"I do not intend to offend Mr. Keister, or to criticise or downgrade his really admirable work in this area, and I do not want to start a controversy, but I feel that you should be given this information. I leave it up to you to publish my letter, or parts of it, in order to convey my experience with the water-soluble flux to other interested people. It will save them lots of grief."

*—Vic F. Steuer, Manufacturing Research Engineer, Burroughs Corp.*

*Salem, Va.*

"In regards to your cover picture on your August, 1961 issue, one can always 'prove' that a watch is an unreliable piece of equipment by hitting it with a hammer. The fact that electrical porcelain may be broken when dropped three feet onto a concrete floor might be a startling discovery for some; I am sure that those same people would be equally amazed to learn that when correctly applied, the same porcelain can be pushed into solid steel plate.

"Every housewife knows that porcelain can be broken by misapplication; the use of such pictures as your cover picture indicates that someone is reinventing the wheel. Such a picture would be quite proper were it used in a plastics trade journal, but hardly in a journal devoted to electrical insulation which is attempting to raise the technical level of the field."

*—Carl T. Durham, Jr., Development Engineer, Advance Engineering, General Electric Co.*

Editor's Note: *If we took the position that we should not publish illustrations or data which compare two different materials under certain conditions since all materials are satisfactory providing they are not misapplied, we would be very limited as to the type of material we can publish. Comparisons are normally of high interest to our readers and in this case the photograph was designed to merely indicate comparative shock resistance as explained in the last paragraph on page 35. We must take for granted that our readers will understand that if shock resistance is not important (as is the case in many, many porcelain applications), that porcelain would be entirely suitable providing it meets other conditions of use. In the past we have published articles on various ceramics and we shall do so in the future—if such an article points out that in a specific application a glass reinforced polyester part was prone to fail because of heat while porcelain had the necessary heat resistance, we would not hesitate to include such a comparison.*

*Passaic, N. J.*

"Many of us at Okonite read the article on page 10 of the October issue of *Insulation*, in which your European editor brought out the facts on Mr. J. P. Sabot's article on the 'Continuous Testing of the Ionization in Medium Voltage Electric Cables.'

"The space given over to this re-

port conveys the idea that this type of testing is something new and unusual. Nothing could be more incorrect. We have been using a continuous ionization testing machine in regular production since 1954. This is well known in the electrical trade in the United States and Europe. The patent on which this and any other similar machines have been designed is U. S. Patent 2460107, applied for in 1945 and issued in 1949 to H. B. Slade, Okonite's Manager of Quality Control. There has been considerable publicity on this.

"I should make note at this point that, although the original patent was granted in the U.S.A., no attempt was made to patent generally in Europe or other foreign countries. Several such machines have since been built in Europe, notably in England, France and Italy, as the European cable technicians quickly saw the significance of this non-destructive testing principle.

"In the meantime, I wonder if you would not think it advisable to make some editorial reference to Okonite's pioneer efforts in the field of continuous testing of ionization in cables, rather than leave the impression that American ingenuity has been scooped by Europeans."

*—Richard S. Hayes, Director of Public Relations, The Okonite Co.*

*Toronto, Ontario*

"I was very much interested in the article by Messrs. Hackney and Scardina entitled 'Selecting Insulation Systems for Rotating Machinery' published in the October issue of your journal, and should like to offer the following comments.

"The comparison between unvarnished and epoxy resin potted twisted pairs of 'Formvar' wire and polyester wire suggests some further considerations. Consider the areas bounded by the limits of 95% confidence as may be extracted from the temperature versus average life graphs shown in figures 3 and 4 of the quoted article. It is found that the temperature values belonging to a given average life within the limits of 95% confidence are nearly the same for either the 'Formvar' or polyester wires. Comparing this with the great difference between the temperature values belonging to a given average life of the unvarnished wires, the effect of the potting appears very great. Replotting figures 3 and 4 of the quoted article on one composite graph shows these relationships with good emphasis. The thought suggests itself that the epoxy resin potted twisted pair tests show the temperature versus life characteristics of the potting compound with very little effect of the wire enamel. If the mass of the potting compound, that is the same for both systems, was significantly greater than the mass of the wire enamel, that is 'Formvar' in one system and polyester in the other, then it is easy to understand how and why the individual time-temperature characteristic of the individual wire enamels was overshadowed beyond recognition. It is thought that for a number of combinations of wire enamels and potting compounds the time-temperature characteristic of the combination depends not only on the individual properties of the wire enamels and potting compounds but also on the mass of the compound relative to the wire enamel. This principle is naturally not limited to wire enamels and potting components but extends to other combinations also."

*—John R. M. Szogyen, Chief Rotating Machine Engineer, English Electric Canada.*

---

## *Redetermination of NBS Unit of Resistance*

A redetermination, based on the prototype standards of length and time, of the National Bureau of Standards' primary unit of resistance has been made using a new method. The evaluation is based on a computable capacitor. The measurements involve an impedance step-up and a new type of frequency-dependent bridge, and give the unit of resistance as $1.000002_3$ ohms $\pm 2.1$ ppm.

# *Pixilated Patents*

*By Mike Rivise*

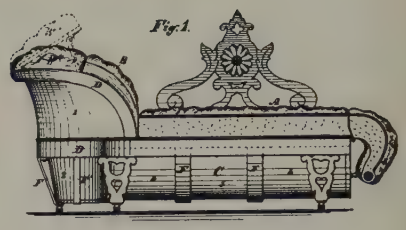
*Sixtieth in a series of odd and interesting inventions in the electronics field from the files of the U. S. Patent Office.*

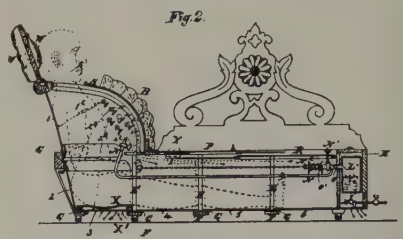
This month's patent concerns an item that, with a little up-dating in style, might be just the thing for the modern efficiency apartment. It could be used as a lounge for friends or as an electrocution chamber for those you secretly hate. All you would have to do would be to persuade them to take a bath in it. It might also prove to be a tidy solution to the problem of where to put mother-in-law in the small apartment.

Patented by J. H. Lea Mond on October 12, 1880, it was designed for ordinary lounge use and also for the treatment of diseases by vapor or liquid baths, in combination with electricity.

As shown in figure 1, the apparatus is arranged and combined so that a complete lounge is formed for ordinary use, having a cushioned seat (A) and head rest (B); but underneath the seat is a bath receptacle (C). This receptacle is formed of several plates of metal (1, 2, 3, 4, 5, 6) suspended transversely in the frame (D) by broad straps or curved plates, and with spaces (E) between them in which an insulating substance of some kind is placed to insulate the plates from each other, so that the plate at the head may be insulated from each of the intermediate ones and be connected to the foot plate, or either or any of the others.

To each of the several sections of metal are connected wires ($1^e$, $2^e$, $3^e$) which are attached to binding screws (H) located on the side and near the head of the bath tub so that the patient may connect or disconnect




either or all of the plates with a battery or any agent for generating the electric current.

At the foot of the bath tub a chamber (K) is formed for holding the generator of the vapor or the heated air, and in this chamber is a boiler (L) for holding water over a gas-burner (M) or other source of heat. A pipe (N) leading from the boiler or vaporizer conducts the vapor of the water along the side of the tub toward the front. This tube or pipe is provided with stop-cocks (N′) and ($N^2$), whereby the vapor can be controlled. Another tube or inlet pipe (O) is also connected to the boiler, and extends into the bath tube a short distance at the foot. It is provided with a valve or plug on its inner end which is held closed by a spring (O′), which presses the plug into or upon the mouth of the tube O to close it, but which may be drawn away with a cord or chain ($O^2$) by the patient to vary the temperature.

Adjustable seats (X) are also provided for the comfort of the patient, each seat consisting of a frame over which perforated material is stricted. Underneath the seat are perforations (X′) in the bottom of the bath tub to permit cold air to rise to keep the hips of the patient cool (it would also hasten the onset of *rigor mortis*).

The entire apparatus could be mounted on casters. This makes it easy to get rid of the body.

# Cable's best friend

## General Electric silicone rubber insulation protects against heat, overloads, ozone, aging, moisture and radiation

**Double Capacity, Overload Protection** — When used to insulate cable, silicone rubber gives you up to *twice* the current capacity, *twice* the overload protection as ordinary insulation. The superior electrical properties and wide operating temperature range of silicone rubber are the reasons.

**Greater Reliability, Longer Life** — G-E silicone rubber insulation has long service life at temperatures from −55°C to 200°C, and it is virtually ageless under severe conditions of heat, ozone, sub-freezing, moisture, and radiation. Trust it to keep working long after ordinary insulation fails.

**Possible Cost Savings!** What's the price difference? More often than not, *none at all.* In old installations, use it in *existing* conduits. Capacity and protection goes up, costs go down. On new installations, you are buying the extra capacity and overload protection needed in the years ahead. Sound electrical insurance.

**Get the full story on cable's best friend: silicone rubber. Write: General Electric Company, Silicone Products Dept., Section M1260, Waterford, New York.**

GENERAL ELECTRIC

**Print Ins. 58 on Reader Service Card**

# *Insulation Forum*

This regular monthly feature is built around a timely question concerning the electrical insulation field. Your suggestions for future questions and participation are invited. This month's question is:

*In your opinion, what organizational function and technical responsibilities should Materials and Process Engineering assume with regard to electrical/electronic insulation?*

**M. F. McFadden**

*Head, Materials and Processes Section, Missile and Space Div., Raytheon Co., Bedford, Mass.*

"The organizational function and technical responsibilities of Materials and Process Engineering should be no different for electrical/electronic insulation than for any other materials or processes.

"Materials and Process Engineering should function organizationally as a "liaison engineering service" group, reporting directly to the chief engineer of the facility in which the group is physically located. Where the company is a multi-plant operation, each plant should have its own Materials and Process Engineering group, but the bulk of capability should be centered in the group located in R&D. This group should be staffed principally with experienced chemical and metallurgical engineers who possess a high degree of capability in 1) judging design needs, 2) doing technical writing, and 3) managing work assignments with a minimum of supervision. Laboratories as such should not, in my opinion, be a part of the organizational structure of Materials and Process Engineering.

"The technical responsibilities of Materials and Process Engineering should embrace the following:

1) Establish company policies as regards the applications of materials and processes.

2) Maintain constant vigil of related contractual requirements.

3) Establish and forecast operating man-power and monies.

4) Provide support and work efforts to assure, where expedient, that all materials and process requirements are being complied with.

5) Prepare, approve, and release all company specifications for materials and processes.

6) Initiate and monitor materials tests as necessary."

**W. F. Seubert**

*Manager Engineering and Development, Circle F. Mfg. Co., Trenton, N. J.*

"The organizational function of the materials and process engineering group should include sole responsibility for specifying the most suitable insulating materials for the many different applications involved.

"Technical responsibilities include the following:

1) Keep informed on the latest developments in insulating material.

2) Test and evaluate new materials and determine how they can best be worked into the products of the company.

3) Make continuing checks on old and new materials to determine how they are performing in actual use. This would include a study on how the materials performed during processing, such as do cold-punching materials come out with smooth or rough edges? If not, is the material at fault or is it due to a condition of the blanking and forming tools? Do the materials have dimensional stability and do they conform to other pertinent requirements including moisture absorption, dielectric strength, flame


**NEW JERSEY WOOD FINISHING COMPANY**

**MANUFACTURERS OF FLEXIBLE ELECTRICAL INSULATION • WOODBRIDGE, N. J.**

VARNISHED CAMBRIC CLOTH AND TAPES • VARNISHED "FIBERGLAS"† CLOTH AND TAPES • VARNISHED SILK AND SILK SUBSTITUTE • SYNTHETIC RESINOUS TAPES AND EXTRUDED TUBING • POLYETHYLENE, SHEETS, TAPES AND EXTRUDED TUBING • CABLE WRAPPING TAPES • "VARSIL" SILICONE VARNISHED "FIBERGLAS"† CLOTH AND TAPES • "VARSLOT" COMBINATION SLOT INSULATION: – RAG PAPER AND VARTEX VARNISHED CAMBRIC • FISH PAPER AND VARTEX VARNISHED CAMBRIC • RAG PAPER AND "MYLAR"* POLYESTER FILM • ASBESTOS PAPER AND "MYLAR"* POLYESTER FILM • KRAFT PAPER AND "MYLAR"* POLYESTER FILM • VARTEX VARNISHED "FIBERGLAS"† AND "MYLAR"* POLYESTER FILM • SPECIAL COMBINATIONS AVAILABLE UPON REQUEST

*Mylar, DuPont's registered trademark

†Fiberglas, Owens-Corning Fiberglas registered trademark

**Print Ins. 60 on Reader Service Card**

resistance and arc resistance?

4) Keep posted on AIEE, Underwriters', ASTM, etc., specifications and testing procedures involving insulation.

5) Serve on committees concerned with the modification of the above standards.

6) Meet with sales representatives and technical experts of the various insulation manufacturing companies.

7) Visit as many factories of manufacturers of insulating materials as possible to become familiar with their manufacturing processes, the careful and continuing checking of processes and products, the storage, packaging and other problems encountered in this business.

8) Cooperate with suppliers of insulating materials by keeping them informed on your insulation problems, the good or unsatisfactory results obtained during evaluation and use of their products."

***A. M. Arnt***

*Senior Design Engineer, Transformer and Coil Div., Dormeyer Industries, Chicago, Ill.*

"I believe that Materials and Process Engineering should assume responsibility for electrical and electronic insulation to the extent that it:

1) Writes the detailed specifications for the Purchasing Department to use in insulation procurement.

2) Prescribes the type and extent of tests which Incoming Material Inspection must make on purchased insulation.

3) Conducts all investigations involving the suitability of insulation or insulating components, when the manufacturer cannot supply satisfactory data.

"It is recognized that in many plants, Materials and Process Engineering may be combined with Design, or Product, Engineering. This is simply a variation in organizational structure. The point to be emphasized is that insulation has become so complex in its nature and application that a specialized knowledge is needed to deal with it. It seems neither reasonable nor fair to expect a Purchasing Department to have such knowledge."

# *Gen. Schriever to Address February Insulation Conference, Tour Details, Other Events and Plans Announced*

Arrangements for the February 19-22 Electrical Insulation Conference are moving along at a fast pace—highlighting the news is the announcement that General Bernard A. Schriever, the man in charge of Air Force research and development, will be the main speaker at the conference banquet on Wednesday evening, Feb. 21.

The conference is sponsored jointly by the American Institute of Electrical Engineers and the National Electrical Manufacturers Association. The meeting is being held at the Shoreham Hotel in Washington, D.C. Technical papers and commercial exhibits are important parts of the conference. In addition to the details given here, readers should refer to pages 36 and 94 of the November issue of *Insulation* for other information on the conference since the November issue covered completely some of the activities which are planned.

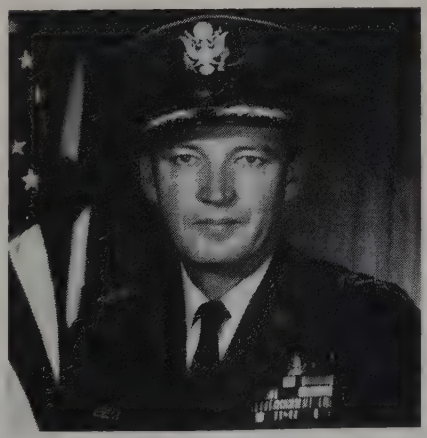
#### Schriever to Address Banquet

Gen. Bernard A. Schriever, USAF, chief of the Air Force Systems Command, described as the "General of Outer Space" in a recent Saturday Evening Post article, will address the Wednesday evening "Unity of Action" banquet during the conference. He will be introduced by Dr. William R. Collings, president, Dow Corning Corp., who will serve as toastmaster.

Gen. Schriever, who was promoted to four-star rank on July 1, 1961, assumed leadership of the newly created and expanded Air Force Systems Command earlier this year. Responsible for Air Force research and development, as well as most of the Defense Department's aerospace activities, Gen. Schriever includes the Midas and Samos early-warning and reconnaissance satellites among the multi-million dollar defense programs under his direction.

The 50-year old general participated in seven campaigns in World War 2 during service as a major with the 19th Bomb Group in the Southwest Pacific. Since that time his career has been increasingly research oriented. In 1954, with the rank of brigadier general, he assumed command of the Air Force Ballistic Missile Division. Under his leadership the ICBM program accelerated into high gear with Atlas, Titan, Thor, and Minuteman as its mainstays.

He is a leading exponent of military space programs and an outspoken critic of any arbitrary division of space activities for peaceful and military purposes. In a speech before the Electronic Industries Association he made the point that total failure in launching and operating space vehicles could be made a thing of the past by patterning functions of their man-made electronic nervous systems on the behaviour of living organisms. He observed that unlike present missile and satellite mechanisms which can fail completely with the malfunctioning of a single part, living mechanisms remain functional despite partial damage.



*Gen. Schriever*

Based on the success of past banquets, it is expected that attendance at the 1962 banquet will hit a record-breaking 1500. Banquet tickets at $15 each may be purchased in any quantity. Complete tables of 10 can be reserved for those who wish to group together their business associates, friends, or clients. Tickets may be obtained from banquet ticket chairman E. J. Phelan, General Manager, Prehler Electrical Insulation Co., 2300 N. Kilbourn Ave., Chicago 39, Ill.

In addition to the address by Gen. Schriever, other features are planned to make the banquet both interesting and enjoyable. A number of leading government and industry leaders will be seated at the head table.

#### Interesting Tours Slated

For those attending the conference, military and space research centers in the Washington, D.C. area will display the latest in nuclear, aerospace, and weapons technology. Tours have been scheduled through the Naval Ordnance Laboratory, the SM-1 Nuclear Reactor installation at Fort Belvoir, and Goddard Space Flight Center of the National Aeronautics and Space Administration. Because of certain government restrictions, it is important that all those desiring to make these tours indicate this fact immediately by filling out the postage-free business reply card which is a part of the conference advertisement appearing on page 17 in this issue.

The Naval Ordnance Laboratory at Silver Spring, Md. is the Navy's primary research and development establishment. Among the installations to be viewed are wind tunnels, pressurized ballistics ranges, environmental evaluation laboratory, plastics laboratory, 100-foot mine test tank, and equipment for precise simulation, control, and measurement of magnetic fields.

The Fort Belvoir nuclear reactor installation tour will emphasize a pressurized water reactor operating at a power level of 10 megawatts. It is

the prototype of a family of reactors designed for portability to, and installation at remote military installations.

The tour to the NASA Goddard Space Flight Center at Greenbelt, Md. will include visits to the Central Flight Control and Range Operations Laboratory, the Space Sciences and Satellite Applications Laboratory, and the Test and Evaluation Center.

#### AIEE and NEMA Luncheons

At the AIEE luncheon on Thursday, Feb. 22, Dr. Jack Behrman, an expert in the field of international trade and finance, and currently deputy assistant secretary of commerce for international affairs, will be the featured speaker. He will speak on "International Technical Cooperation—Its Impact on Our Future in World Markets." Prior to his appointment in the Department of Commerce, Dr. Behrman held a professorship in economics and business administration at the University of Delaware and was a consultant and lecturer on problems relating to financing foreign economic growth.

As previously announced in the November issue, at the NEMA luncheon on Tuesday, Feb. 20, Kenneth W. Haagensen, director of public relations of Allis-Chalmers Mfg. Co., will speak on "We've Got What It Takes, If We'll Only Take What We've Got" —a dynamic presentation covering the elements of public relations, sales, and human relations.

The marketers' program, to be held Monday afternoon and evening, Feb. 19, will be the kickoff event for the conference. William Ruder, assistant secretary of commerce, will be the keynote speaker, setting the pace with a discussion of "Your Product—Your Market." George Ganzenmuller, Electrical Wholesaling editor, will follow with an address on product distribution. He will also participate in a panel discussion, along with representatives of manufacturing, distributing, purchasing, and selling functions.

A cocktail hour and dinner, winding up the marketers' program, are also scheduled. The evening speaker will be the well known TV personality, Billy Sands, who portrays Private Caparelli on the Sgt. Bilko show. A special marketing award presentation will also be a program feature.

#### Technical Program

Refer to the November issue of *Insulation* for a complete listing of all papers and authors tentatively scheduled. A total of 16 technical sessions will be held with five to six papers presented in each session (total of 86 papers). Session themes include: Using Insulation in Dry-Type and Gas-Filled Transformers; The Future of Switchgear Insulation; Encapsulated Distribution Transformers; Integral HP Motors—High Temperature Performance; Encapsulated Motors; Fractional Horsepower Motors; Servicing and Maintenance of Rotating Machinery.

Also: Basic Insulation Behaviour; Temperature Classification and Thermal Endurance; Aging Techniques; Insulation Resistance Measurements; International Insulation Technology; Resins for Electronic Packaging; Encapsulated Magnetic Components; Advances in Materials for Electronic Components; and Thin Film and Electrolytic Capacitors.

#### Golden Omega Award

Another feature of the Wednesday evening conference banquet will be the presentation of the Golden Omega Award, donated by *Insulation*, to an outstanding national figure responsible for important technological contributions. Previous recipients were Vice Admiral Hyman Rickover, leader in the nuclear ship program, and Dr. Mervin J. Kelly, former head of the Bell Telephone Laboratories, who had much to do with the development of the transistor.

Shailer L. Bass, executive vice president of Dow Corning Corp., is serving as chairman of the Golden Omega Award Selection Committee. Other committee members include William Rodich, president, Continental-Diamond Fibre Corp.; W. H. Chase, president, American Institute of Electrical Engineers; Max McGraw, chairman of the executive committee, McGraw-Edison Co.; and Dr. John Hutcheson, vice president, Westinghouse Electric Corp.

#### Education Committee

The conference has also announced the formation of a committee on education consisting of 22 leaders in the fields of education and research. Objectives include: sponsorship and improvement of courses in electrical insulation; support of insulation fellowships; distribution of appropriate publications to colleges and libraries; and emphasis on the key position of electrical insulation science and technology. N. M. Bashara, professor of electrical engineering at the University of Nebraska, is serving as chairman of the committee. Vice chairman is A. E. Javitz, Electro-Technology.

#### Commercial Exhibits

Refer to the November issue of *Insulation* for a complete listing of the companies who have already contracted for more than 100 exhibit spaces at the conference. Later information may be obtained from commercial exhibit chairman William J. Dwyer, Suflex Corp., 33-40 57th St., Woodside 77, N.Y.

#### Special Conference Issue of Insulation

As in past years, *Insulation* will use its regular issue to provide complete and up-to-date information on the conference program, exhibits, tours, points of interest, luncheons, banquets, and other conference highlights. In addition to all these details on the conference in the regular February issue, it will feature a special editorial report consisting of a series of 13 exclusive, high interest articles developed around the theme of "The Insulation Challenge." These articles are designed to shock, interest, and challenge readers — they'll tell you where insulation technology stands today and where it has to get to in a hurry if this country is to meet the crucial domestic and world-wide challenges which face us. A star-studded cast of expert, well-known authors are preparing these articles with the introduction being written by Dr. Wernher von Braun, the famous missile leader.

Copies of the February issue will be distributed without charge to registrants at the conference.

# *Dielectric Loss Yardsticks*

*By John C. Botts, Manager, Insulation Development Section, Development Engineering, Large Rotating Apparatus Department, and Graham Lee Moses, Manager, Services Engineering, Large Rotating Apparatus Department, both of Westinghouse Electric Corp., East Pittsburgh, Pa.*

### *Introduction*

Energy dissipated within a dielectric is of great importance to the performance of any insulation material or system because these power losses may be indicative of destruction of the insulation by several mechanisms. This is true not only because of the power loss within the dielectric, but it may also indicate other deteriorating influences are present, such as corona in internal voids. On the other hand, high dielectric losses may be due to a variety of other phenomena, such as the resistance component of the insulation or the intermolecular friction caused by the migration of dissolved impurity ions and the rotation of the dipoles.

An understanding of the causes for dielectric loss is of the greatest importance because no two materials or systems react in exactly the same way to the various causes and effects of dielectric loss. Therefore, a knowledge of the loss characteristics alone is not necessarily indicative of the quality level of different kinds of insulation. One of the major uses of dielectric loss data is to determine the degree of fill and/or the presence of internal voids in an insulation, or to determine the presence of corona within these internal voids or adjacent to the surface of the insulation.

### *Fundamental Relations and Formulae*

An insulation material or an insulation system under electrical stress may be compared directly with an electrical capacitor. The ideal capacitor or the ideal insulation would have a current component which leads the voltage component by 90 degrees. However, since the perfect capacitor is never quite attainable, a resistance component will always be present. There will result a voltage-current relationship which differs from the ideal capacitor relationship by a factor determined by this resistance component. The magnitude of this resistance will determine the amount of power dissipated in the insulation structure when subjected to voltage and represents a loss. Figure 1 shows that an insulating material between two electrical conductors can usually be represented, for purposes of a-c measurements, by its equivalent parallel capacitance, $C_p$ and its equivalent parallel resistance, $R_p$. It may also be represented by its equivalent series capacitance and resistance, $C_s$ and $R_s$ respectively. Figure 2 shows the vector diagrams of the relationships between voltage and current in both cases. The difference between the resultant voltage E and

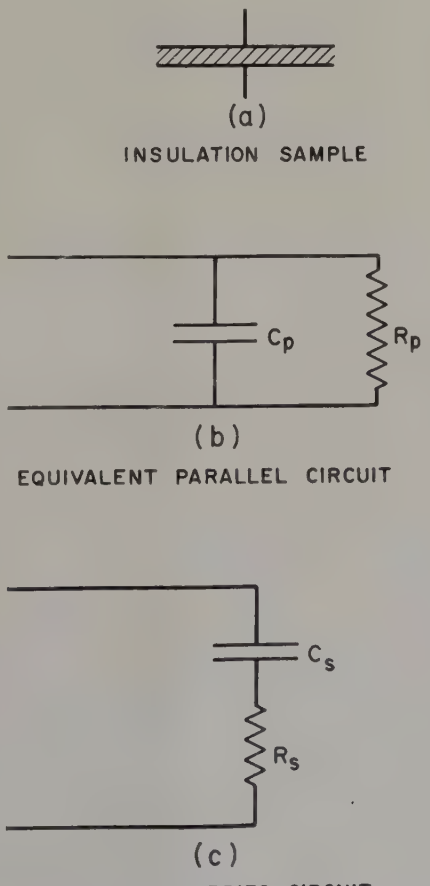



*Figure 1, insulation sample and equivalent circuits.*

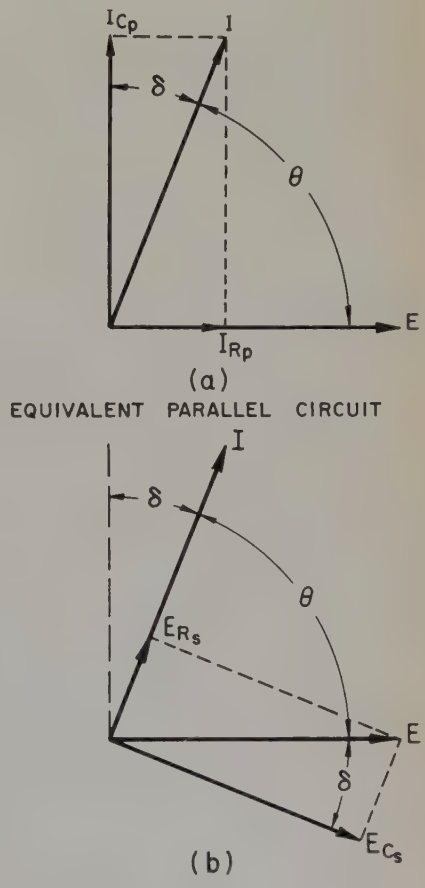



*Figure 2, vector diagrams for equivalent circuits.*

current I is shown by the angle Θ. For dielectric measurements, the "dielectric loss angle," which is 90°—Θ, is more convenient and more commonly used than the phase angle Θ. (It is also called the "dielectric phase defect angle" or "dielectric phase difference," but is universally symbolized by δ.

The dielectric power factor is cosine Θ, or sin δ, and is the same as the power factor in ordinary a-c power metering except that the current is leading instead of lagging. When the power factor, sin δ is less than 0.10 (10%), it is practically equal to tan δ. Most measuring devices read tan δ, not sin δ, and the reading has often been called "power factor." To avoid this confusion, the term "dissipation factor" has been coined for tan δ.

Although the power factor or dissipation factor of an insulation sample is commonly used alone as an indication of its quality, it really should not be so used except in comparison of samples of the same kind with a standard of known quality.

Another and perhaps better criterion of insulation quality, if low power loss in the insulation is important, is the loss factor, defined as the product of the dielectric constant and the tangent of the loss angle; i.e.,

$$\text{Loss factor} = K \tan \delta$$

The dielectric constant, K, or the S.I.C. (specific inductive capacity) are numerically the same and the terms are commonly used synonymously. The equivalent British term is "permittivity,"

$$K = \text{S.I.C.} = \frac{C_p}{C_v}$$

in which $C_p$ is the equivalent parallel inter-electrode capacitance of the specimen and $C_v$ the inter-electrode capacitance of the same electrode arrangement with a vacuum (or air) as the dielectric.

The equivalent capacitance of the insulation can also be used as a measure of dielectric loss. Investigators have been able to show a direct relationship between the change in capacitance as a function of voltage and the actual volume of voids or ionizable materials present in the insulation system.

#### *Instrumentation*

One of the more common means of measuring dielectric loss is the Schering bridge which is illustrated in figure 3. The Schering bridge essentially is a bridge circuit which will balance the capacitance and resistance load of the test specimen against a standard capacitor and adjustable resistances and capacitances. This bridge works similarly to the well-known Wheatstone bridge except that it is multidimensional and takes into account the vector relationships of the current and voltage; whereas, the Wheatstone bridge measures only resistances with the voltage current relationships in phase.

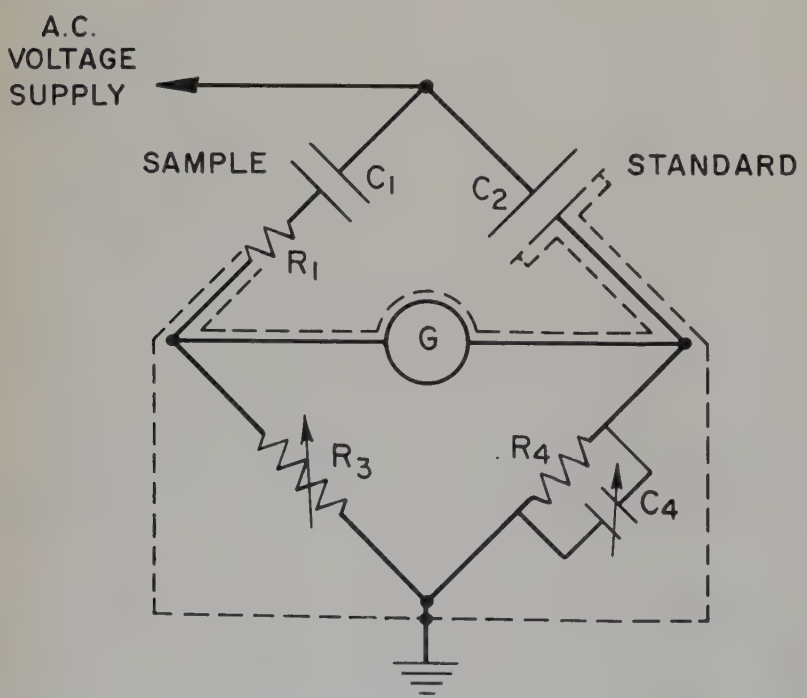



*Figure 3, simplified Schering bridge.*

The equivalent circuits do not fully duplicate the properties of insulation samples which have absorption and distort the shape of the current wave; i.e., introduce harmonics. Samples having absorption to a marked degree resemble a complicated network of capacitors and resistors in series and in parallel. Such samples cannot be perfectly balanced in a bridge against a simple equivalent circuit unless the galvanometer in the bridge is tuned so as to be sensitive only to the fundamental frequency. The detector G in figure 3 is sharply tuned to the frequency of the power supply and will balance to a null reading in spite of large harmonics in the current through the sample, so that any sample is read in terms of its simple equivalent circuit and the definitions of factors used in evaluating materials are based on such readings.

Without going into the mathematics, the following somewhat simplified relationships can be shown from the schematic of the Schering bridge.

The equivalent series capacitance of the specimen $C_1 = \frac{C_2 R_4}{R_3}$

The equivalent parallel capacitance of specimen $C_1 = \frac{C_2 R_4}{R_3} \cos^2 \delta$

The dissipation factor $\tan \delta = \frac{\omega C_4 R_4}{10^6}$

in which $C_4$ is in microfarads and $\omega = 2\pi \times$ frequency.

If $R_4$ in ohms $= \frac{10^6}{\omega}$ (for 60 cycles $R_4$ is equal to $\frac{10^6}{2\pi \times 60} = 2{,}653$ ohms)

Then $\tan \delta = \frac{\omega C_4}{10^6} \times \frac{10^6}{\omega} = C_4$ in which $C_4$ is in microfarads.

There are other bridge circuits which are also capable of measuring the dielectric losses of insulation samples. Recently Dakin and Malin-

aric[4] have taken an old established principle, using oscillograms of corona discharge current versus applied voltage, and by use of a capacitance bridge circuit have been able to estimate the volume of voids present in the insulation.

Power factor can also be measured with a voltmeter, ammeter, and wattmeter since power factor actually is the ratio of energy loss in a dielectric system to the volt-ampere input. Since high sensitivity is required, this requires a special variety of meters and is not a simple or practical set-up for many uses. However, there are commercially available instruments which operate on this principle.

#### Measurements

An insulation may be considered to be made up of various non-homogeneous dielectrics in series. For example, an insulation may have a solid dielectric in series with air spacing in the simplest case. Since the solid dielectric and the air space have different dielectric constants there will result an unequal voltage distribution across the total thickness. At voltages below breakdown of any of the component dielectrics, the power factor or dissipation factor will be dependent upon the complex combination of the resistance and capacitance components of all of these materials. As the voltage is increased, it is possible that the breakdown voltage of one of the components, such as a void or air pocket, may be exceeded by the voltage impressed across it, resulting in a breakdown of that component. When this breakdown occurs it essentially changes the ionized dielectric to a different equivalent resistance and capacitance. This impresses a different amount of the voltage upon the other dielectric material. Thus, the system has changed to an insulation with a different combination of capacitors and resistances, resulting in an insulation with a different dielectric loss. This change is detectable by many dielectric loss measurements.

This is perhaps one of the more common ways of using dielectric loss as a measure of the quality of insulation materials or systems. The dielec-

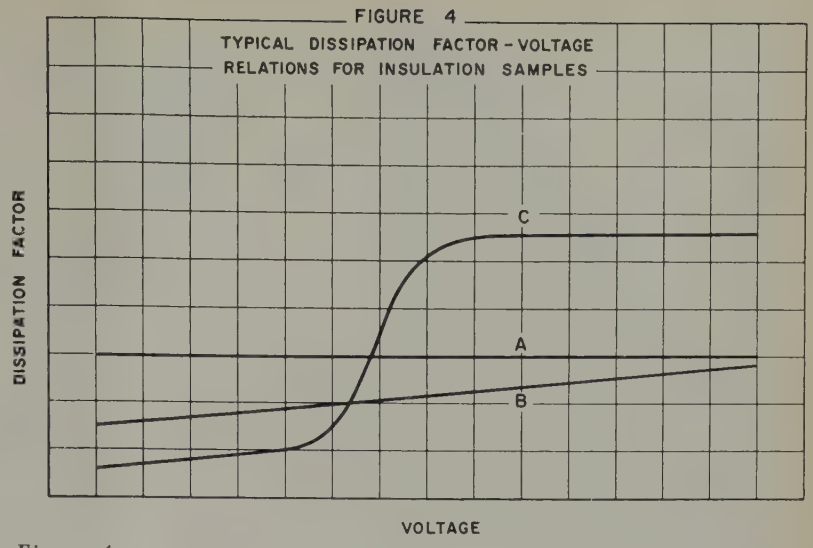



*Figure 4.*

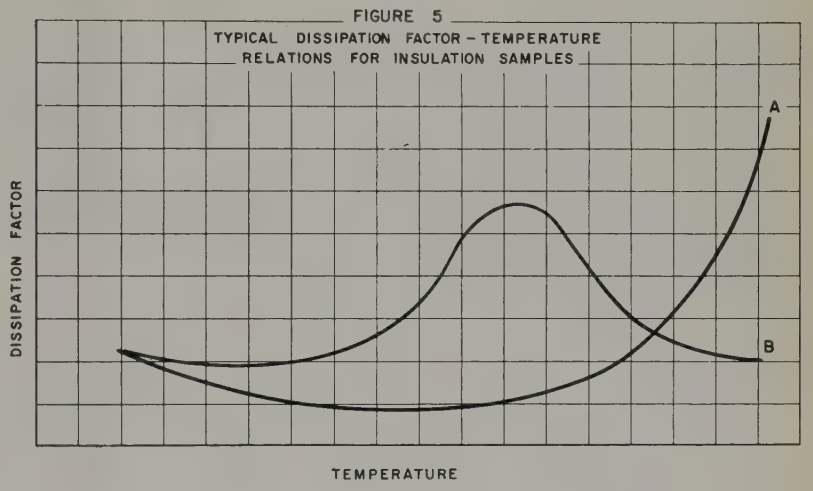



*Figure 5.*

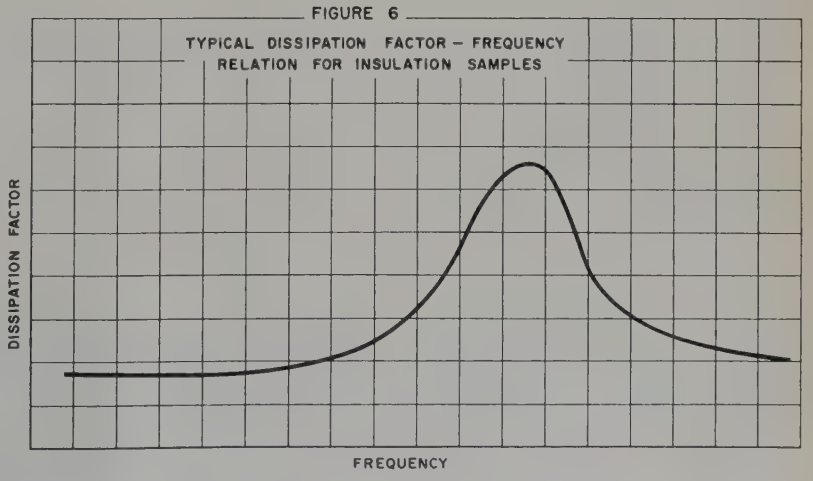



*Figure 6.*

tric loss is measured as a function of voltage and by noting the place where a sudden change in the dielectric loss takes place, it is usual to conclude that this represents breakdown of a certain portion of the insulation such as internal air spacing or voids. When this sudden change occurs in any of the dielectric loss yardsticks, internal ionization and corona is then considered to be present. This may well be true, but it does not take into account the ability or inability of the particular insulation to resist this internal corona. Also, it does not necessarily follow that because a change in dielectric loss occurs that this is brought about by internal ionization of the voids or gas pockets. Other factors may bring about a change in tangent delta as a function of voltage. When a voltage is impressed across a dielectric, the polar molecules try to align themselves and the dissolved ions move in the direction of the voltage stress. Thus, as the stress alternates with a-c, the dissolved ions must move back and the polar molecules must realign themselves each time the voltage reverses. There is a certain physical resistance on the part of these molecules and ions to move with these voltage alternations. It is not uncommon to find materials which have different levels of dielectric loss as the alternating voltage is increased. However, this is usually reflected in a continuous change in the dissipation factor as a function of voltage rather than the sudden change which occurs due to ionization. Thus, in measuring any particular dielectric, the observation may include not only internal ionization but changes due to increasing intermolecular friction of the polar molecules and dissolved ions.

Figure 4 shows several different typical dissipation factor versus voltage curves which may be found in different insulation materials and systems. Curve A shows the ideal condition where the dissipation factor is flat in slope and does not change as a function of voltage. This would be the ideal dielectric insofar as dissipation factor is concerned. Curve B shows a typical dissipation factor-voltage curve where the dissipation factor increases steadily as a function of voltage. This is typical of the insulation where the intermolecular friction caused by the rotation of the dipoles changes as a function of the voltage. This might be considered to be a typical dielectric. Curve C is the type of dissipation factor voltage curve that might be obtained on an insulation which has included voids. It can be seen that there are usually two inflection points in this curve, the first being where ionization begins which is often used as an indication of the presence of corona. However, it should be pointed out in examining all of these curves that the measurement of dielectric loss is not a simple matter. It is extremely important that the investigator be absolutely certain that the properties of the desired material are being measured. Usually the investigator is desirous of measuring the properties through the insulation under test but it should be remembered that parallel paths exist over the surface of the insulation. Therefore, it is very important that guard circuits be used to guard out the parallel surface paths. In addition, the edge effects of the electrodes can have a great influence upon the dissipation factor and it is extremely important that the guard circuits be so designed as to maintain the uniform dielectric field through the material under test. Other factors, such as electrode contact resistance and the inclusion of air between the sample and the electrode, can also affect the readings. Care must be taken to make sure that these factors do not give erroneous results.

The overall electrical properties cannot be inferred from the shape of these curves or from the level of the power factor. Air is very nearly a perfect dielectric insofar as dielectric loss level is concerned and is relatively constant as a function of voltage. Yet air has a relatively low electric strength when compared with many insulating materials. Also, it is not difficult to find a composite insulation with a dissipation factor similar to B which can readily be changed to shape C by the inclusion of voids within the insulation. However, usually no correlation can be found between the shape of the power factor curve and the electric strength, even with air included in solid insulation unless the level approaches unity. This is because although the dissipation factor curve may show the air to be present, if the solid dielectric material is capable of withstanding the ionization, the electric strength will not be significantly different.

The presence of moisture in insulation may be detected by a change in dissipation factor. Moisture lowers the insulation resistance, thereby increasing the losses and at the same time often increases capacitance by its effect on dielectric constant.

Temperature is an important factor in dielectric loss and must be taken into account when measurements are made. Figure 5 shows how typical materials may react as a function of temperature. Many materials will show a decrease in dissipation factor from room temperature to some intermediate value but then will eventually start to increase quite rapidly as shown in A. Other materials will experience peaks of maximum loss as shown in B. Here again much of the phenomena is brought about by the movement of the dissolved ions and the rotation of the dipoles. Curve A may be representative of a dielectric where the movement of the dissolved ions predominates and Curve B the rotation of the dipoles. Dissipation factor is usually only important within the temperature range wherein the insulation may be operated. As in the case of dissipation factor versus voltage, no direct correlation between dissipation factor and temperature with electric strength may necessarily be found. When power factor levels approach unity the insulation becomes an a-c resistance and runaway conditions may exist wherein falling resistance increases power losses which further increases temperature eventually causing thermal breakdown. However, dissipation factor levels on materials in the range of 40 to 50% have frequently not been correlated with electric strength of the insulation. Dissipation factor will also be affected by the frequency of the a-c voltage source. Usually

there is some frequency at which the dissipation will peak in such a fashion as shown in figure 6.

Dissipation factor data are more meaningful when used on a comparative basis rather than as absolute values. By measuring dissipation factor as a function of thermal aging it is possible to determine if significant changes are taking place, not only in the level of dissipation factor but the shape of the curve as a function of other variables such as voltage and temperature. If there are indications that changes are taking place in the insulation, it should not be inferred that this change is harmful. Only careful consideration of all factors should lead to this conclusion.

### Summary

Dielectric loss is a good comparative evaluation for some characteristics of insulation. It may be used for comparing similar samples of the same materials. It may not be used as an overall evaluation for comparing different materials.

Many variables affect these measurements. All must be known, understood, and correlated in reaching a judgment.

Specific uses of dielectric loss measurements must be on a comparative basis. Typical uses are:

a. Observing reproducibility of manufacturing process.
b. Comparing size and frequency of internal voids.
c. Observing moisture content.
d. Detecting presence of corona and comparing levels.
e. Observing changes as function of various environmental conditions and deteriorating influences.

### Bibliography

1. Insulation Engineering Fundamentals (Book), Graham Lee Moses, Lake Publishing Company, 1958.
2. Methods of Test for A-C Capacitance, Dielectric Constant, and Loss Characteristics of Electrical Insulating Materials (Tentative), ASTM Standards on Electrical Insulating Materials, D 150-54T, Page 61.
3. The Relation of Capacitance Increase with High Voltages to Internal Electric Discharges and Discharging Void Volume, Thomas W. Dakin, AIEE Transactions, pt. III (Power Apparatus and Systems), Vol. 78, October 1959, pp. 790-95.
4. A Capacitance Bridge Method for Measuring Integrated Corona-Charge Transfer and Power Loss per Cycle, T.W. Dakin and P.J. Malinaric, AIEE Paper 60-97, Winter General Meeting, New York, January 31-February 5, 1960, (Power Apparatus and Systems, October 1960).

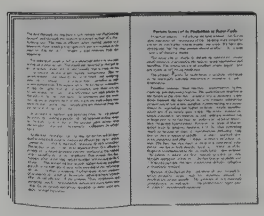
# There's a lot of energy in noxious fumes!

*Here are the facts:* Heat Recovery from low-temperature, flameless catalytic fume oxidation is a practical, proven method of utilizing energy that would otherwise be lost to the atmosphere. In addition, catalytic oxidation destroys fumes and odors, eliminates noxious air pollutants, aids production, builds employee morale, reduces wear and corrosion of plant equipment, reduces fire hazards and improves insurance position.

Catalytic Combustion pioneered the development and applications of catalysts in fume and odor control systems. Today more than 1,500 ovens in the wire enameling industry alone are using Catalytic Combustion systems. In addition many paint baking, metal decorating, paper printing, organic coating and curing and paper impregnating ovens and dryers are also profitably using catalytic oxidation systems.

Initial investment costs of catalyst elements on continuous ovens can often be recovered through heat recovery in a matter of months. Elimination of equipment downtime, safer, more healthful working conditions, and improved community relations, also contribute operating profits.

Catalytic Combustion elements are built to standard sizes and complete systems are custom engineered to maximum effectiveness.



**Learn the facts** *about Heat Recovery and Air Correction... write "Department A" for our brochure.*

**CATALYTIC COMBUSTION** CORPORATION

*4725 Fourteenth Street • Detroit 8, Michigan*

A SUBSIDIARY OF UNIVERSAL OIL PRODUCTS COMPANY

**Print Ins. 2 on Reader Service Card**

# *A-C Anodization of Aluminum Wire In Sulfuric Acid Solution*

## *Part 2 — Electrical Properties of Anodic Films*

*By Wm. H. Fischer and J. A. Consiglio, General Engineering Laboratory, General Electric Co., Schenectady, N. Y.*

### Introduction

In a previous paper[1] a pilot plant process for the continuous strand anodization of aluminum in sulfuric acid solutions was described. This work was undertaken primarily to satisfy a demand for high temperature electrical components. It was theorized that a process of anodization employing a-c in a solvent-type electrolyte would produce a superior wire insulation.

The initial investigation demonstrated that the process could be easily controlled to give practical anodic films on aluminum. It is the objective of this paper to describe some of the electrical properties of the films produced.

### Film Evaluation

To evaluate the effects of the process variables and to assess the electrical properties, it was necessary to set up a standardized testing program. The anodized aluminum wire was conditioned prior to testing by drying for 24 hours at 150°C, followed by 24 hours in 50% relative humidity at 24°C. These conditions were selected after exploratory tests showed little difference in final test results after longer periods of drying or exposure to moisture.

The electrical tests employed are (1) room temperature a-c dielectric strength on 12x and 6x mandrels using 3-turn coils wound under a tensile stress of 1375 psi to determine dielectric strength and reduction of dielectric strength with flexing; (2) a-c dielectric strength; and (3) d-c insulation resistance at temperatures up to 600°C on a 16x mandrel using 12-turn coils wound under a tensile stress of 1250 psi to determine dielectric strength and insulation resistance as functions of temperature.

In addition, single scrape abrasion resistance, thickness, and apparent density of the anodic films were determined as previously described[1].

No thermal aging tests have yet been performed.

### Process Variables

*Annealing temperature* was varied from 400 to 550°C in 50°C steps. The a-c dielectric strength showed a peak at 500°C.

*Electrolyte temperature* was varied from 0 to 21°C in 5°C steps. The a-c dielectric strength exhibited a peak at 15°C.

*Residence time* in the anodizing bath was varied from 21 to 180 seconds. At residence times below about 60 seconds no detectable anodic film was formed, but thereafter a-c dielectric strength increased linearly with residence time.

*Apparent current density* was varied from 1 to 3.5 amp/sq ft. The a-c dielectric strength manifested a peak at 2 amp/sq ft.

The foregoing data, coupled with that of the previous paper[1], shows that as the aluminum wire progresses through the anodizing bath, the anodic film gradually builds up in thickness and density with a resultant increase in electrical properties. It is not absolutely clear from the original data whether or not an equilibrium condition between electrochemical film formation and chemical film dissolution in the solvent-type electro-

**Table 1—Typical Round Wire Properties**

| *A-C Dielectric Strength (Volts)* | | |
|---|---|---|
| Mandrel (x) | Temp. (°C) | Volts |
| 16 | 23 | 266 |
| | 300 | 270 |
| | 400 | 246 |
| | 500 | 250 |
| | 600 | 193 |
| | 23 on cooling | 346 |
| 6 | 23 | 250 |
| 12 | 23 | 300 |
| *D-C Insulation Resistance* | | |
| | Temp. (°C) | Ohms |
| | 23 | $5.6 \times 10^7$ |
| | 300 | $6.3 \times 10^8$ |
| | 400 | $5.1 \times 10^7$ |
| | 500 | $5.4 \times 10^7$ |
| | 600 | $6.0 \times 10^6$ |
| | 23 on cooling | $1.6 \times 10^8$ |
| Single Scrape Abrasion Load (gm) | | 420 |
| Film Thickness (inches) | | 0.00065 |
| Film Density (gm./cm.$^3$) | | 2.02 |

*Samples annealed at 500°C, degreased, electrolyte temperature 15°C, residence time 120 seconds, forming voltage 60 volts, current density 2.2 amperes per square inch.*

**Table 2—Typical Rectangular Wire Properties**
*Wire Size 0.355" x 0.095"*

| Property | Sample 1 | 2 | 3 |
|---|---|---|---|
| a-c Dielectric Strength | | | |
| on flats | 210 ±40 | 423 | 235 |
| on edges | 230 ±60 | 219 | ----- |
| 2 layers crossed at right angles | | | 400 |
| Single Scrape Abrasion Load (gm.) | | | 400 |
| Film Thickness (inches) | | 0.00075 | 0.0011 |

lyte is attained prior to emergence from the bath, but indications are that net growth of the film has stopped, and that it is not increasing in thickness, although the substrate is still decreasing in diameter.

### Typical Wire Properties

Typical anodic films formed in contact with 40 wt. % sulfuric acid solutions have the properties given in table 1.

Both 16x mandrel a-c dielectric strength and d-c insulation resistance show an initial increase from room temperature values to a plateau followed by a decline as the test temperature is increased. The increase is due to the removal of moisture introduced by the 50% RH of the test room as is shown by the higher room temperature values immediately after heating. The decline is the usual resistance-temperature effect to be expected. However, the long plateau extending over more than 200°C is unusual. Previous workers[2] found a constant value from room temperature to 600° C. However, they do not state whether their measurements were made in an ascending or descending temperature order. If descending, the moisture effect might not be observed if the anodic film is tested before it becomes equilibrated with ambient moisture.

The 6x and 12x mandrel data are included for comparison purposes.

In addition to round wire, rectangular wires can also be easily anodized by the present process, as is shown by the data in table 2.

The lower a-c dielectric strength on the flats of sample 3 as compared with sample 2 in table 2 is due to the difference in film thickness. In order to produce thick anodic films, high a-c forming voltages must be impressed on the anodizing media. However, this often results in arcing at the wire surface, probably due to surface imperfections, which punctures the anodic film. These punctures immediately begin to reanodize, but they are always thinner than the unpunctured firm resulting in lowered dielectric strength. The apparent density of the anodic film behaves similarly.

### Sealing

A common shortcoming of previous anodized aluminum insulations was the decrease in their electrical properties brought about by high humidities or free moisture. Several sealing techniques have been proposed to overcome this. As part of this investigation, sealing techniques were investigated. We have developed a sealing technique employing chlorinated hydrocarbons which is superior to those that have heretofore been available. A sample of anodized aluminum wire whose dry a-c dielectric strength on a 6x mandrel was 252 volts fell to only 194 volts following a three-hour water soak after sealing. Another sample with a dry a-c dielectric strength on a 12x mandrel of 300 volts, fell to 170 volts when wet, but had a value of 285 volts when water soaked for three hours after sealing. The sealing was stil effective after exposure to 250° C for 90 hours.

### Conclusion

The data of tables 1 and 2 indicates that the anodic film formed directly on an aluminum wire conductor by the present process is capable of being used in many applications as an electrical insulator particularly at elevated temperatures where the usual organic insulations are seriously degraded or destroyed. Thus, anodized aluminum magnet wire could be applied in transformers, solenoids, torque motors, or reactors where high ambient or operating temperatures are experienced. Even long term elevated temperatures should be much less damaging than when organic insulations are used. The presence of organic solvents should not affect the electrical properties of the anodic film.

### References


1. Fischer, Wm. H. and Consiglio, J.A., "A-C Anodization of Alumin in Sulfuric Acid Solutions. Part 1—Pilot Plant Process," *Insulation*, Nov. 1961, page 31-35.
2. Smits, P., "Anodized Aluminum Wire," *Modern Metals*, 14 (1958) 30-32.

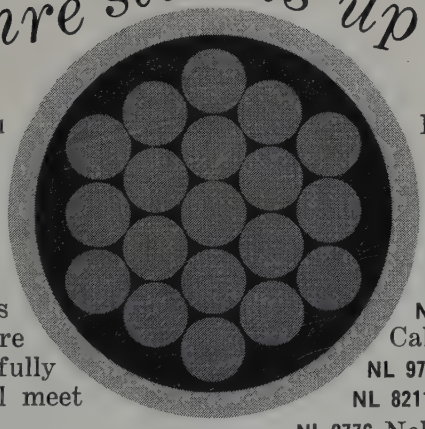

### Insulation for Radiation Articles Available

An article discussing the effects of radiation on the properties of organic polymers, written by Arthur Bradley, Director of Research, Radiation Research Corp., is presented in the November and December issues of Plastics Design & Processing. *Insulation* readers desiring copies of this two-part article can obtain them by writing:

The Editor
Plastics Design
& Processing
Lake Publishing Corp.
Box 270, 311 E. Park Ave.
Libertyville, Ill.

Another article by Mr. Bradley which discusses inorganic insulation for radiation appeared in the October issue of *Insulation*, page 23.

# *Nelco coated wire stands up to the elements*



What's the "hidden ingredient" you look for in a lacquer? It's the organization behind it. Research. Testing facilities. Pilot plant runs. Production capacity. And of course experience.

That's what makes Nelco lacquers the *lacquers with a difference.* They're not just "mixed" — they're carefully *formulated* to make certain they'll meet your strictest specifications.

Of our hundreds of stock formulations for wire and cable coating, we've listed a few here. With our unique facilities we can *custom* formulate still others to meet special requirements.

Send for the Nelco Data Book. You'll have facts — at your fingertips — for every construction. Or send us information on your coating problems.

Look at this array of lacquers. High temperature resistant. Clear, glossy film. Flame retardant. Fray prevention. MIL spec. finishes. Fungus resistant.

**NL 7147** Nelco Clear Cable Coating
**NL 8223** Nelco Clear Heat Resistant Cable Coating
**NL 9731** Nelco Flame Retardant Saturant
**NL 8211** Nelco Moisture Resistant Saturant
**NL 9776** Nelco Clear Cellulose Acetate Cable Coating
**R 4026** Nelco High Temperature Resistant Cable Coating
**R 5979** Nelco Clear Nylon Cable Coating
**R 6625** Nelco Ribbon Cable Adhesive

*Back of Nelco lacquers are 40 years experience serving the wire and cable industry.*

NELCO LACQUERS

*Not just mixed ... they're formulated*

NELCO LACQUER DIVISION, **CHEMICAL PRODUCTS CORPORATION,** EAST PROVIDENCE, RHODE ISLAND

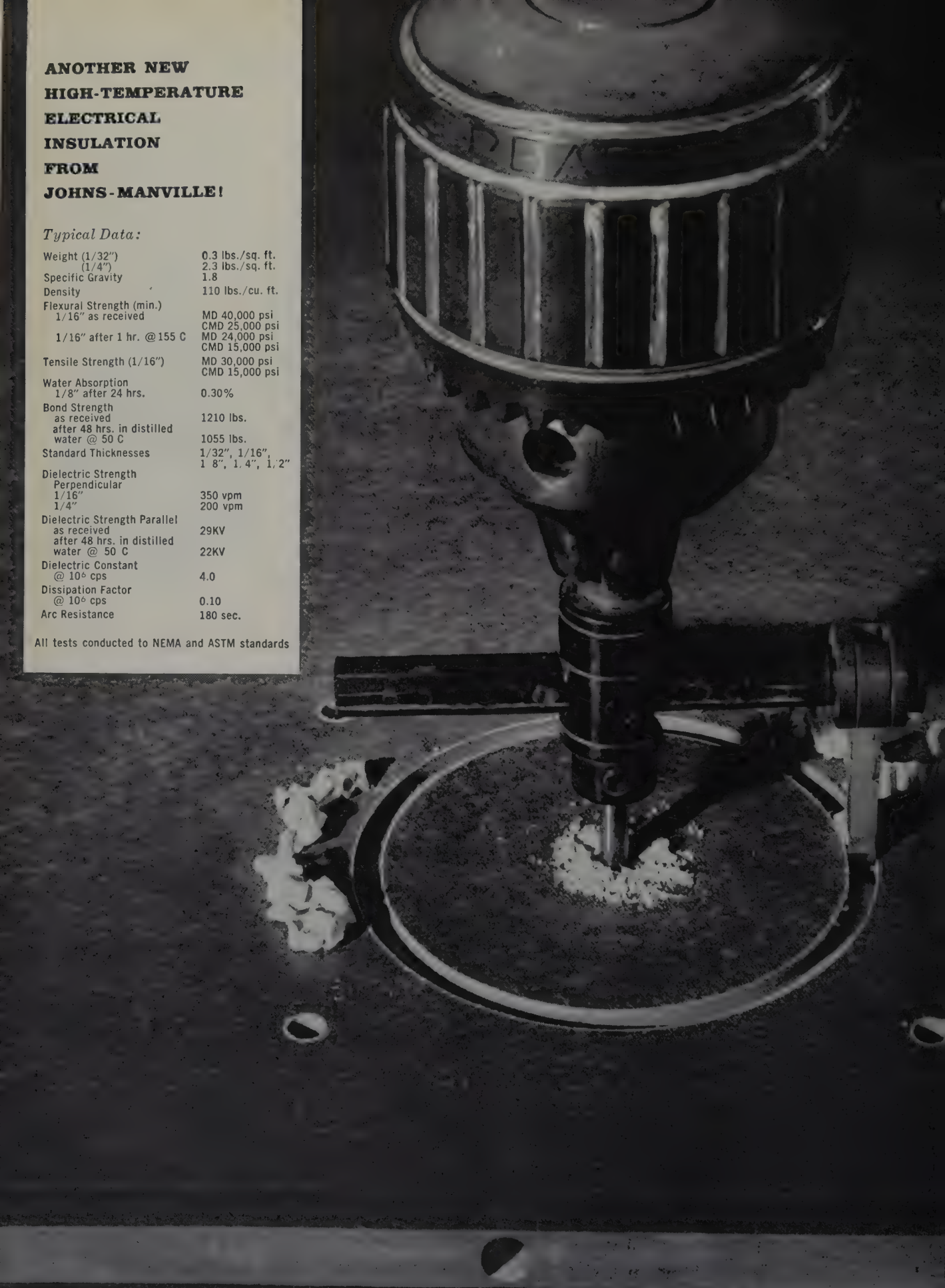
***Print Ins. 3 on Reader Service Card***

**ANOTHER NEW HIGH-TEMPERATURE ELECTRICAL INSULATION FROM JOHNS-MANVILLE!**

*Typical Data:*

| | |
|---|---|
| Weight (1/32") | 0.3 lbs./sq. ft. |
| (1/4") | 2.3 lbs./sq. ft. |
| Specific Gravity | 1.8 |
| Density | 110 lbs./cu. ft. |
| Flexural Strength (min.) | |
| 1/16" as received | MD 40,000 psi<br>CMD 25,000 psi |
| 1/16" after 1 hr. @155 C | MD 24,000 psi<br>CMD 15,000 psi |
| Tensile Strength (1/16") | MD 30,000 psi<br>CMD 15,000 psi |
| Water Absorption | |
| 1/8" after 24 hrs. | 0.30% |
| Bond Strength | |
| as received | 1210 lbs. |
| after 48 hrs. in distilled water @ 50 C | 1055 lbs. |
| Standard Thicknesses | 1/32", 1/16", 1/8", 1/4", 1/2" |
| Dielectric Strength Perpendicular | |
| 1/16" | 350 vpm |
| 1/4" | 200 vpm |
| Dielectric Strength Parallel | |
| as received | 29KV |
| after 48 hrs. in distilled water @ 50 C | 22KV |
| Dielectric Constant @ $10^6$ cps | 4.0 |
| Dissipation Factor @ $10^6$ cps | 0.10 |
| Arc Resistance | 180 sec. |

All tests conducted to NEMA and ASTM standards



J-M No. 880 Quinterrabord being fabricated by Asbeka Asbestos Machining Corp., Brooklyn 23, N. Y

# Announcing:

# Johns-Manville

# No. 880

## QUINTERRABORD®

*–a radically new asbestos-polyester laminate for applications to 50KV.*

*Strong and rigid...easy to machine... for temperatures in the 155 C range!*

Here's an unusually strong and dense–yet easily machined–electrical laminate that out-performs glass-polyester laminates after prolonged exposure to high temperatures and extreme humidity. Under boiling water tests, No. 880 Quinterrabord shows very high retention of its original flexural strength of 40,000 psi. Thus you can count on the reliability of No. 880 Quinterrabord for a wide variety of motor and transformer applications, as well as for panelboards and printed circuit bases.

No. 880 Quinterrabord is produced by combining highly purified asbestos paper and an exclusive polyester resin developed by J-M research. *It is far stronger dielectrically . . . far stronger mechanically than any NEMA Grade A or AA laminate made.* The advantages of No. 880 Quinterrabord include:

- **MACHINES, STAMPS AND PUNCHES AS EASILY AS J-M ASBESTOS EBONY®** with the lowest tool wear of all inorganic laminates.
- **EXTREMELY LOW IN COST** – usually less than two dollars a pound.
- **HIGH DIELECTRIC STRENGTH** does not change significantly, even after prolonged exposure to heat and humidity.
- **HIGH MECHANICAL STRENGTH**, including flexural, even after exposure to boiling water.
- **UNUSUAL ARC RESISTANCE** – higher than glass-polyesters.
- **BODY STRUCTURE MAINTAINED** even if fire destroys organics.

Write, wire or phone now for complete technical data on J-M No. 880 Quinterrabord. Johns-Manville, Box 359, New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

*Print Ins. 4 on Reader Service Card*

# *More on Insulation Folklore*

## *Permeability Losses in Potted Magnetic Components*

*By R. B. Feuchtbaum, Member of Technical Staff, Materials and Processes Section, Hughes Aircraft Co., Culver City, Cal.*

*Ed. Note:* This is the second "folklore" article prepared by author Feuchtbaum. The first dealt with whether or not failures were caused by shrinkage of encapsulating resins and appeared in the May 1961 issue of *Insulation*. Readers are invited to submit their own "folklore" articles on any subject related to insulation.

•

The sun rises in the east, ascends to its zenith, and then sets in the west. The very terms we use in our everyday language to describe the daily apparent course of the sun reflects mistaken concepts based on one of the earliest observations of primitive man: Since the heavens turned about the earth, who could deny that man and his mighty world were the hub of the universe?

Even modern technology is not entirely free of mistaken explanations based on the apparent correlation between two or more totally independent chains of circumstance. Such a chain of circumstance might be forged in the following way.

If a deforming stress is placed on a highly oriented, or high permeability magnetic lamination, the lamination suffers a permanent loss of permeability. The original properties of the materials can only be restored by a reorientation of the grain structure, or by a complicated stress-relief cycle in a hydrogen annealing furnace.

Certain magnetic components exhibit a sharp decrease in permeability when they are potted or encapsulated with a resin that is "rigid" at room temperature.

The stress sensitive laminations are apparently deformed by the rigid resin, with the resulting loss in permeability. However, magnetic components potted or encapsulated with a resin that is "flexible" at room temperature show no change in inductance when checked after the resin treatment. The stress sensitive laminations are not deformed by the flexible resins and therefore there is no "permanent" loss in permeability.

The relationship of the preceding phenomena seems straightforward and clear cut. The relationship of the following events on the surface might appear to be a little more obscure.

In Alaska during a mid-November alert, a transient failure appears and disappears during the period an intercepter is taxiing out on the strip.

In Thule, in December, a fire control system is examined for an intermittent "open capacitor" and no defective components are found.

A subsystem failure on a satellite designed to conduct a series of experiments in the earth's shadow renders most of the electronic gear worthless.

The links that join these isolated entities into a chain of related, pertinent facts, are a few key phrases contained in MIL-T-27A and some scientific observations presented in several recent papers.

"All measurements, unless specified otherwise, shall be carried out at 25°C—5°C+10°C."

"The units shall be capable of performing under all climatic conditions."

Now let us integrate the previous statements with some additional evidence. A cursory examination of the relative strengths of thermosetting plastics and the various iron alloys used for magnetic laminations will quickly indicate that there is no plastic available from the current state-of-the-art that can stress a ferrous material up to, and beyond, its yield point.

Fischell[1, 2] demonstrated that pressures as small as 500 pounds per square inch could cause appreciable drops in the permeability of the stressed magnetic lamination. The permeability returns to its normal pre-stress level when the pressure is removed.

Hanson and Tuzinski[3] demonstrated that flexible resins go through a brittle point at some temperature below normal room ambients. As the resin passes through this transition temperature, strain gauges buried in the plastic show the development of pressures in excess of 500 psi.

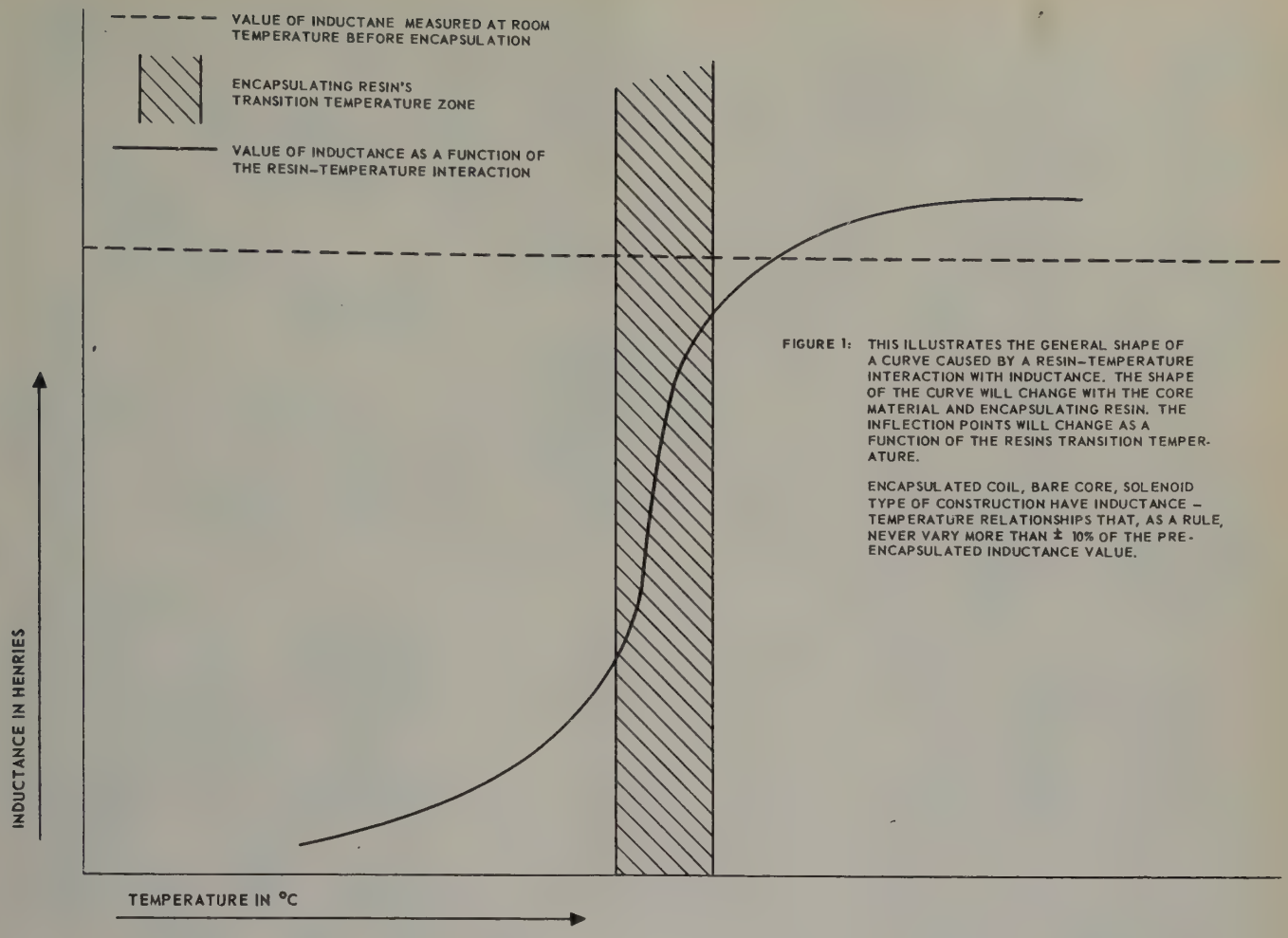



FIGURE 1: THIS ILLUSTRATES THE GENERAL SHAPE OF A CURVE CAUSED BY A RESIN–TEMPERATURE INTERACTION WITH INDUCTANCE. THE SHAPE OF THE CURVE WILL CHANGE WITH THE CORE MATERIAL AND ENCAPSULATING RESIN. THE INFLECTION POINTS WILL CHANGE AS A FUNCTION OF THE RESINS TRANSITION TEMPERATURE.

ENCAPSULATED COIL, BARE CORE, SOLENOID TYPE OF CONSTRUCTION HAVE INDUCTANCE – TEMPERATURE RELATIONSHIPS THAT, AS A RULE, NEVER VARY MORE THAN ± 10% OF THE PRE-ENCAPSULATED INDUCTANCE VALUE.

Other workers[4] have reported that the effect of the resin on standard lamination magnetic cores is independent of the mass of the resin. The effect seems to be entirely a function of the temperature of the resin's transition point, and whether the measurements were made above or below this temperature. These effects are completely reversible, and the measured inductances rise and fall with the temperatures at which the measurements are performed (see figure 1).

The effects observed by Fischell, Hanson, and Tuzinski interact to produce the "Temperature Coefficient of Inductance."

It would seem that any "sensitive" magnetic component that is completely encapsulated or potted with a resinous material will lose a large portion of its permeability once a certain critical temperature is passed.

The obvious solution would be to encapsulate just the coil and leave the laminations bare. Certain military specification requirements and some design considerations make this direct approach unfeasible in a number of instances.

The obscure, though potentially more rewarding, solution might be to investigate these phenomena exhaustively to determine the exact nature of the mechanism and how it might be controlled.

In the interim, the government specifications should provide for an adequate warm-up time for magnetic components where such a course is feasible. If it is not practical to allow for a warm-up time, the units should be measured at the ambient temperatures after a sufficiently long soak period to insure temperature equilibrium.

In some instances, the manufacturer might find it necessary to conduct a series of empirical experiments to determine the insulation system that will give the smallest temperature coefficient of inductance for his unit-temperature requirements.

A great deal of investigation in this area is currently being conducted at the Hughes Aircraft Company. These investigations are especially important in the light of the reliability requirements of the Surveyor Lunar Probe project, where ambient conditions will range from —250°F to +250°F over a minimum operational life period of 30 days.

### References


1. Fischell, R. F., "Magnetic Effects of Compressional Stress at Low Field Intensities," AIEE Trans., 75, 148-151, May 1956.
2. Fischell, R. F., "Effects of Transverse Compressional Stress on Magnetic Laminations," AIEE Trans., 74, 190-193, May 1955.
3. Hanson, W. M., and Tuzinski, J. R., "Strain Gauge Evaluation of Flexible Epoxy Resins," Second National Conference on the Application of Electrical Insulation, Washington, D.C., December 1959.
4. Feuchtbaum, R. B., Gurevics, D., and Hutter, J., "Temperature Coefficient of Epoxy Molded Audio Transformers and Inductors," First National Conference on the Application of Electrical Insulation, Cleveland, Ohio, September, 1958.


West Virginia manufactures a complete line of electrical insulating pressboard. Each Westvaco grade is designed for a specific category of uses. Depending on the application, you may choose from Pressite or UL recognized Electrite and Densite. ■ Westvaco pressboards are made from 100% virgin kraft pulp in our own mills. Complete product control from forest to you assures uniform quality and unsurpassed purity, with no metallic particles. More economical too. ■ **Pressite.** Absorbent and unsized pressboard... for air, oil and askarel transformers and capacitors. ■ **Densite.** Extremely hard, for punchings; sized for moisture resistance or unsized for applications in oil. ■ **Electrite.** Hard, with high tensile strength for clean, smooth punchings. Natural rosin sized to resist moisture. ■ **Thermally Upgraded Board.** West Virginia is an approved source of thermally upgraded pressboard for all principal oil-filled transformer insulating systems. ■ For full information, samples and a copy of Underwriters' Laboratories Report # E 3987, write today to Board Products Sales, West Virginia Pulp and Paper Co., Covington, Va.

**West Virginia Pulp and Paper**

***Print Ins. 5 on Reader Service Card***

# *Impregnation Fundamentals*

*By G. Robert Cox, President, J. D. Devine Manufacturing Co., Pittsburgh, Penn., and Edward B. Stuart, Consulting Chemical Engineer and Associate Professor of Chemical Engineering at the University of Pittsburgh, Pittsburgh, Penn.*

The term impregnation is used to describe the process of filling the interstices of a porous or void containing piece of equipment with a resinous dielectric material. The objective is to fill all spaces between conductors with a homogeneous, dry, monolithic, low power factor, high BIL (Basic Impulse Level) material.

Successful impregnation requires the elimination of all atmospheric, surface, and adsorbed moisture and as much air as possible. It has been found that even very small discontinuities are likely to cause corona effect and progressive failure of the insulation.

The removal of air or other gases can be accomplished fairly easily by subjecting the parts to a vacuum. Although the parts may be rather complex, the flow rates of gases at the low pressures are still rapid enough that the achievement of the low pressure in the center of a complex unit can be realized in a comparatively short time. The amount of air or gas remaining in the interior of the electrical equipment is then primarily dependent upon the degree of vacuum, or absolute pressure that can be achieved with the vacuum system.

The removal of moisture is a little more complex. Moisture that is contained in the air or gas that initially fills the equipment before evacuation will be removed as a vapor in the normal process of pumping down. Moisture that adheres to the surface or remains within the equipment in the liquid phase must be removed by the combination of low pressure and heat. The amount of heat that is required to remove this liquid water can be determined by estimating the amount of moisture that is present within the equipment and supplying the appropriate latent heat of vaporization. Mantell[1] describes a process of moisture removal from an adsorber designed to retain moisture on the surface of a very strong dessicant. Moisture adsorbed on the surface of the metallic wires, the insulation, and the metal case of a complex unit will be held by adsorptive forces that are possibly of the same order of magnitude or less than those found in a dessicant. The data that Mantell reports indicates that the moisture can be removed from a dessicant adequately if the temperature of the dessicant is reasonably high. In his particular example, it was raised to about 250°F. In general, adsorbed moisture is removed if the temperature is raised and the partial pressure of water vapor above the surface is lowered. A combination of evacuation and heating of the material for impregnation should also remove the adsorbed moisture.

Moisture that is physically adsorbed to the surface of a solid is held by forces approximately equal to the heats of liquefaction. The amount of heat then, that would be necessary to remove adsorbed moisture would be similar to the amount of heat that would be required to vaporize that moisture. It is our opinion that this physically adsorbed moisture is most likely to cause a breakdown of any insulation material since this adsorbed moisture can be easily removed and allowed to enter the insulation space by replacement. Moisture or other contaminants that are adsorbed on the surface more strongly such as chemically adsorbed or "chemisorbed" material would take energies or heats on the order of heats of reaction to remove them from the surface. The chemisorbed matter should not interfere with the finished electrical unit.

In the "baking-out process" it is desirable to have as low a pressure as possible and it is desirable to provide heat to the parts. The amount of heat will be dependent on the amount of moisture present and the heat capacity of the charge and the impregnation chamber. The time required for "baking-out" will be primarily dependent upon the time necessary for the interior of the part or parts to achieve the desired "bake-out" temperature.

There are many variables affecting the rate of penetration of the resin within the equipment after the air and moisture have been removed. As an illustrative example, let us consider a form wound motor coil. A typical small industrial coil might have a cross section similar to that shown in figure 1.

In the impregnation process the flow of resin might be illustrated by taking our typical coil and assuming that the vacuum has been applied and the interior pressure of the coil is $p_o$. Normally the coil is in an evacuated chamber into which resin or impregnating varnish is placed surrounding that coil. After the resin or varnish completely surrounds the coil the evacuated chamber is opened to the atmosphere and/or pressure is applied to force the resin from the

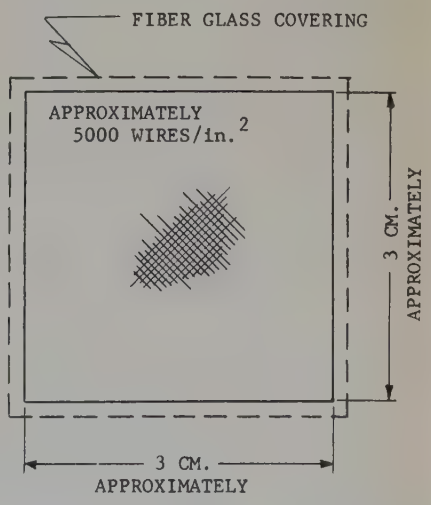



*Figure 1, cross section of typical wire coil.*

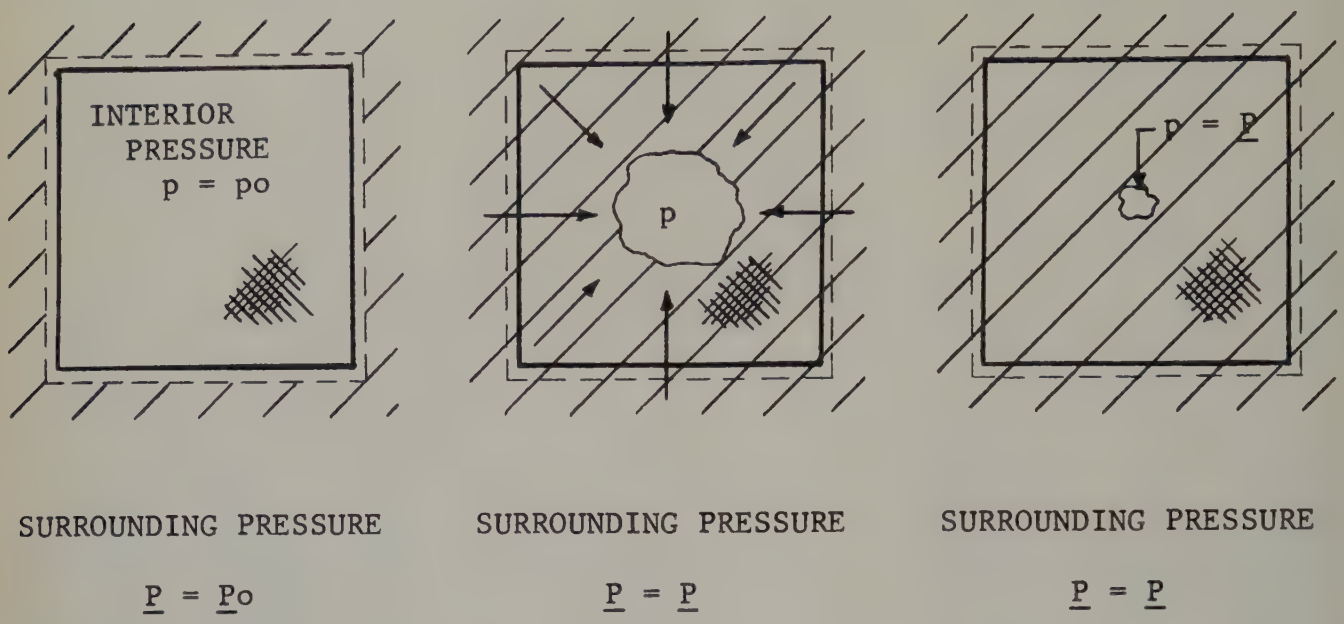



*Figure 2, impregnation process.*

surrounding space into the interior of the coil. The flow of resin to the interior of the coil as a function of time is schematically shown in figure 2.

Initially, when there is no flow the external pressure $P_o$ is equal to the interior pressure, $p_o$. This is equivalent to the situation where the vacuum chamber is charged with impregnant and the chamber has not been opened to let in atmospheric air. At time Θ, the situation is typical of some time after the pressure is applied and the process of resin flow is taking place. Finally, when the core is almost completely filled there is a very small volume of air water vapor or resin solvent at a pressure equal to the external or applied pressure.

The desired condition is one in which the amount of air space left in the unit is infinitesimally small. Theoretically, unless a perfect vacuum were achieved at the beginning of the impregnation and if there is no outlet for the small amount of air at the center, there will always be a small air gap at the center of the core. If the core can be arranged so that resin filling can take place with a small gas outlet or prepared "pocket," this incomplete impregnation can be eliminated.

The resistances to resin flow in our illustrative example would be:

a. Viscous flow pressure drop—normal resistance of the resin or varnish flowing through a porous mass or capillary openings.
b. Interior pressure build-up because of volume decrease of trapped air or solvent vapor.

If only steady-state flow of the impregnant were to be considered, the following equation would be applicable.

$$\frac{\Delta P}{L} = \frac{5v\,\mu\,(1-x)^2 s^2}{g_c x^3} \qquad (1)$$

Where: $\frac{\Delta P}{L}$ = Pressure drop or drive force per unit length.

$v$ = rate of flow of fluid or velocity of fluid.

$\mu$ = viscosity of the fluid.

$x$ = porosity of the part or volume of void space divided by the total volume of the part or unit that is being impregnated.

$s$ = specific surface or surface area per unit volume of the solids within the equipment.

$g_c$ = gravitational convergent constant (32.2 ft/sec$^2$).

Equation (1) is the Kozeny-Carman Equation[2]. Neglecting the other resistances, equation (1) would predict the velocity of resin flow within the interior of the solid of about 3/10th of a millimeter per second under the influence of atmospheric pressure. At this velocity we would have complete impregnation of our sample piece under the influence of one atmosphere of pressure within about one minute time. Obviously this rapid impregnation cannot be achieved because of the build-up of the internal pressure of the small amount of air that is left after the evacuation. The second of the two resistances that we described can be included by considering the coil in

figure 2 at a point when the impregnant is flowing into the wire structure. In figure 3 we have assumed that the inflow will form a boundary approximating a circle.

Neglecting the edges, the thickness may be:

$$r_1 - r = L \qquad (2)$$

and at low pressure the interior pressure, p, may be obtained by using the Ideal Gas Law as in equation (3):

$$p = \frac{NRT}{V} = \frac{P_1 V_1}{V} = \frac{p_1 L' 2\pi r_1^2}{2 L' r^2 \pi} = \frac{p_1 r_1^2}{r^2} \qquad (3)$$

where L′ represents the length of a core segment.

From equations (1) and (3):

$$V = \frac{\left(P - \frac{p_1 r_1^2}{r^2}\right) g_c X^3}{(r_1 - r)\ 5 S^2\ (1\text{-}X)^2} \qquad (4)$$

If our coil sample consists of parallel wires with a wire diameter equal to $\delta$, the area of the wire surface per unit length will be:

$$A_W = \pi \delta$$

and the specific surface would be:

$$s = \frac{\pi \delta}{(\pi/4)\ \delta^2} = \frac{4}{\delta} \qquad (6)$$

If the number of wires per unit coil cross-sectional area is n, then:

$$\delta = \frac{1}{\sqrt{n}} \qquad (7)$$

and finally:

$$s = 4\sqrt{n} \qquad (8)$$

If the porosity is equal to the volume of voids divided by the total volume of the coil, per unit coil length:

$$x = 1 - n\pi/4s^2 \qquad (9)$$

therefore, from equation (8):

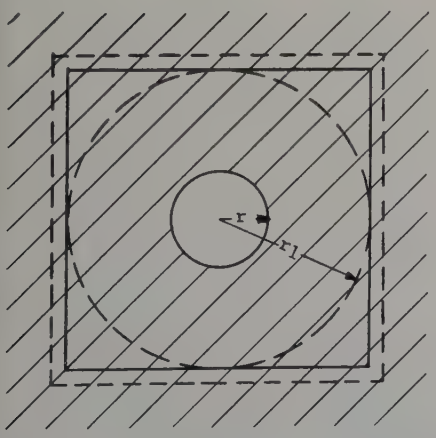



*Figure 3, approximation of impregnant path.*

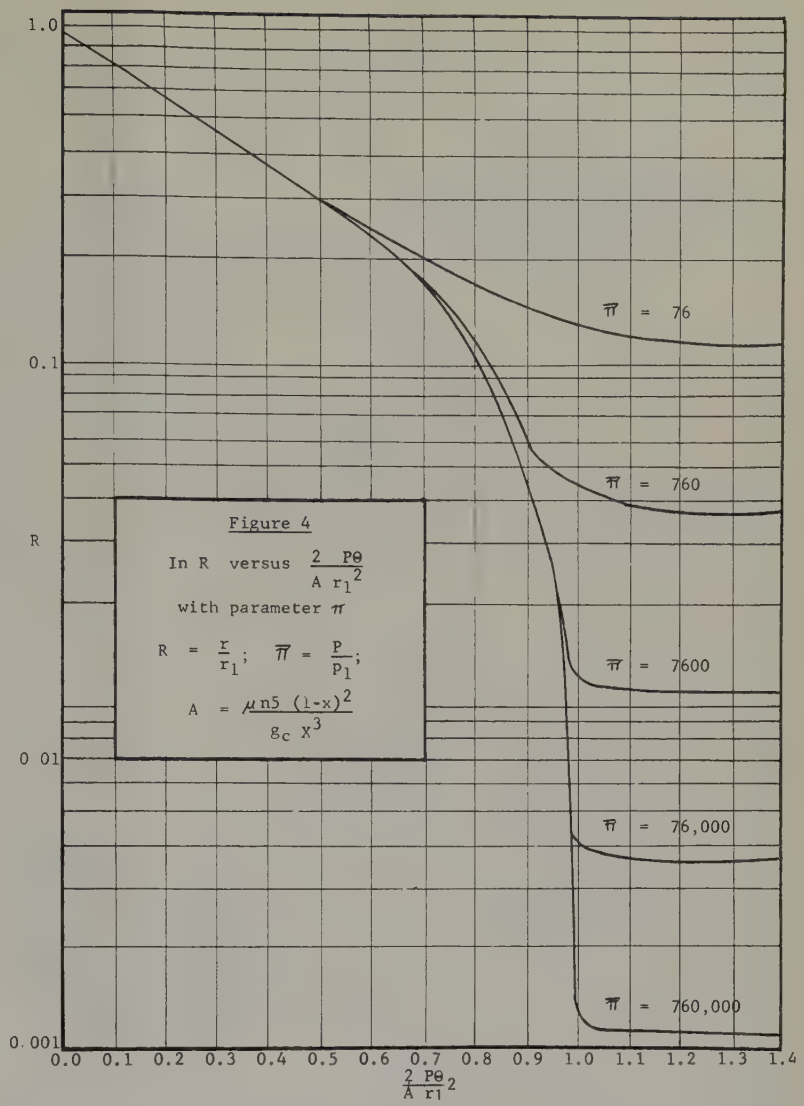



*Figure 4, plot of equation (13)*

**Table 1—Operating Conditions**

| *Condition* | *Remedy* |
|---|---|
| 1. Remaining air or gas gap even after long impregnation times. | a. Reduce the pressure (provide a better vacuum).<br>b. Use a longer "bake-out" period which should remove more water vapor.<br>c. Use a resin with a lower vapor pressure at the impregnation temperature to reduce $P_1$.<br>d. Use a higher pressure P after resin filling. |
| 2. Impregnation times are too long. | a. Decrease the path of impregnant ($r_1$).<br>b. Use a lower viscosity impregnant ($\mu$).<br>c. Use a higher pressure P after resin filling. |

**Table 2—Design Condition**

| *Design Factor* | *Effect* |
|---|---|
| 1. Provide built-in central pocket. | 1. Provide space for remaining air or solvent vapor to minimize required ratio. |
| 2. Use a cylindrical fiber as a filler. | 2. Reduces specific surface to reduce resistance to resin flow. |
| 3. Use thinner sections or provide resin access holes. | 3. a. This reduces minimum radius factor $r_1$.<br>b. Thinner sections would provide for shorter "bake-out" periods, since the center portions would come up to temperature more readily. |

$$x = 0.215 \qquad (10)$$

By combining the definitions of s and x for parallel wires, equation (4) may be written as follows:

$$v = \frac{-dr}{d\Theta} = \frac{P - p_1 r_1^2/r^2}{(r_1 - r)\ 152\ n} \qquad (11)$$

Letting,

$\Pi = P/p_1$, pressure ratio, applied pressure divided by interior pressure after evacuation.

and

$R = r/r_1$, radius ratio, radius of the resin or impregnant front divided by the initial minimum coil radius. $A = \frac{\mu s\ 5\ (1-x)^2}{g_c x^3}$

or

$A = \mu n\ (152)$ assuming parallel wires.

Then

$$\frac{dR}{d\Theta} = \frac{P}{Ar_1^2}\,\frac{(\Pi - 1/R^2)}{1_1(R-1)} \qquad (12)$$

Integrating equation (12) gives the following result:

$$(1-R)^2 + \frac{1}{\Pi}\ln\frac{(\Pi R^2 - 1)}{(\Pi - 1)} - \frac{1}{\sqrt{\Pi}}$$

$$\ln\frac{(1-R\sqrt{\Pi})}{(1+R\sqrt{\Pi}} \times \frac{1+\sqrt{\Pi})}{1-\sqrt{\Pi})} = \frac{2P\Theta}{Ar_1^2} \qquad (13)$$

Although equation (13) looks formidable, a graphical solution is presented in this paper which will enable the engineer to estimate impregnation times under a variety of conditions.

Figure 4 is a plot of equation (13). The dimensionless ratios that were used in the derivation allow the use of this graph for any set of conditions.

The dashed lines refer to limits which are extremely important. The limiting or minimum value of R is determined by the pressure ratio:

$$R_{LIM} = \frac{1}{\sqrt{\Pi}} \qquad (14)$$

As the pressure ratio limit is approached based on equation (14), the time required to reach the desired radius ratio approaches an infinite value.

Although equation (13) and figure 4 represent a qualitative picture of impregnation, they point out the relative values of changes in impregnation operating conditions.

The desired condition is to have the impregnant completely fill all of the void space within the shortest amount of time. From our example and from the above equation you can see that we can never completely eliminate the void space by just mechanically filling the unit. We can approach this condition closely but performance data would tell us the engineering allowances.

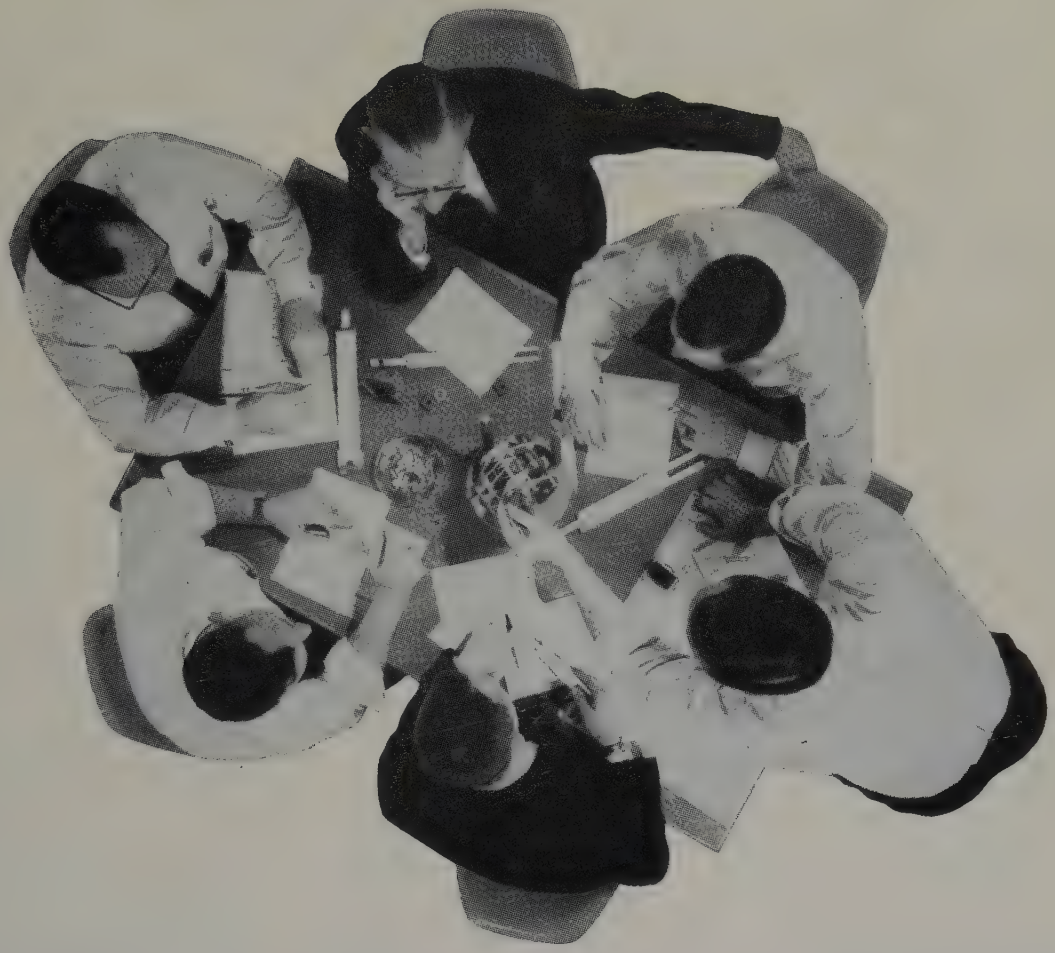
Let us see from our qualitative guides what remedies we can use or what conditions we can control to achieve improved impregnation (refer to table 1).

If the design conditions can be controlled easily, the following items could be incorporated into the unit to allow better and faster impregnation and of course better electrical characteristics based on impregnant homogeneity.

### References

1. Mantell, C. L., "Adsorption," McGraw-Hill Book Co., Inc. New York, 1951, page 396.
2. Brown, G. G., "Unit Operations", J. Wiley and Sons Inc., New York, 1950, page 217.

# LOWER PRODUCTION COSTS START HERE



## . . . with Spaulding Value Analysis Engineers putting their heads together over your product

Spaulding interprets the Value Analysis Process as "a scientific method of accomplishing a function at the lowest possible cost."

That's why Spaulding maintains specially trained Value Analysis Engineers on its sales staff who evaluate a customer's product, then decide how it can be made better, easier, and at a lower cost through the use of a Spaulding material processed by Spaulding's own Fabricating Department.

These men save Spaulding's customers thousands of dollars annually. Why not let them put their heads together for you?

**The Unique Characteristics of these Spaulding Materials and Services Hold Important Advantages for your product.**

Spaulding Vulcanized Fibre: Hard, dense, extremely wear-resistant. One of the best arc-resistant, electrical and heat insulators known to industry.

Spauldite: Industrial plastic laminates.

Spauldo: A 100% rag paper electrical insulation used as motor slot insulation.

Spaulding T: A very high grade fibre board. Also known as Pressboard, Transformer Board and Fuller Board.

Spaulding Armite: An improved thin vulcanized fibre insulation (fish paper).

Spaulding Fibre Board: Made by the wet process from selected fibrous materials in various grades, including resin boards.

Fabrication Facilities: Undivided responsibility from manufacturer to finished part, with the most complete fabricating facilities in the industry.

## SPAULDING FIBRE COMPANY, INC.

357 WHEELER STREET, TONAWANDA, NEW YORK

*Print Ins. 7 on Reader Service Card*

# European Insulation Report

Ed. Note: *The author of this monthly European report is a well-known insulation expert associated with a large European electrical manufacturer. Although it is necessary that his identity not be revealed at this time, correspondence may be exchanged with him by writing* European Editor, Insulation, Box 270, Libertyville, Ill.

•

In the last issue a summary was given of the first paper published at the session organized by the Swiss Association of Electrical Engineers on the use of vacuum in the fabrication of high tension material. All the papers and discussions are published in the Bulletin des Schweizerischen Elektrotechnischen Vereins, Vol. 52, No. 19, 23 rd. September, 1961.

A further paper was presented by P. Stoll titled: The Preparation and Regeneration of Mineral Oils with Special Reference to Transformer Oils. Original title: Aufbereitung und Regenerierung von Mineralölen unter besonderer Berücksichtigung von Transformatorenölen. pp. 764-770. Prof. Dr. P. Stoll is with Micafil A.G., Zurich, Switzerland.

Recently a summary of another article by Prof. Stoll on the same subject was given (See *Insulation*, May 1961. European Report).

A paper was presented by I. Peter (Maschinenfabrik Oerlikon, Zurich, Switzerland) titled: Vacuum Impregnated Insulation of Electrical Machines. Original title: Vakuumimprägnierte Isolationen elektrischer Maschinen, pp. 777-781. This paper adds nothing new to another recent publication by the same author. (See *Insulation*, October 1961 issue).

### Applications of Vacuum in the Commissioning and Repairing of High Voltage Transformers

*By H. Hartmann, pp. 770-774. Original title: Vakuumanwendung bei der Inbetriebnahme und Reparatur von Hochspannungstransformatoren. H. Hartmann is with Nordwestschweizerische Kraftwerke A.G., Baden (A.G.), Switzerland.*

In this paper the author draws from his experiences as an operating engineer. He states that the smaller transformers should be transported from factory to site already filled with oil. The oil coolers should be transported separately but already filled with oil so that no further treatment of the oil after the connection of the coolers is necessary. An oil treatment using a vacuum installation is necessary when empty coolers are connected.

An example is given of the erection of a large transformer, 380 kv rated voltage 400:3 MVA. Each single phase unit weighs 100 tons. This weight was reduced by 30 tons by filling the transformers with dry gas instead of oil for transporting purposes. Special 5-ton containers suitable for both rail and road transport were used for the oil.

A periodical survey of the transformer (insulation, support rings, etc.) is necessary. In order to do this, the transformer core and windings must be lifted out of the oil for the shortest possible time. However, the oily insulation absorbs more humidity than the oil itself. The treatment of the insulation depends on its type, the air humidity, rated voltage, time out of oil, etc., and the following general preparations are given.

If the insulation consists of transformerboard pieces, cylinders and caps, varnish-impregnated conductors, etc., and the time out of the oil is less than 12 hours, it is sufficient to dry out the transformer by putting it back into the oil and recirculating the oil through an oil-treatment installation. This treatment is also sufficient for highly stressed paper insulation after less than 5 hours exposure but it is emphasized that this type of treatment removes only surface moisture. For longer exposures to air, this treatment is not satisfactory without evacuation of the transformer tank. This evacuation is difficult and almost impossible in the average station which doesn't have the necessary installations. Difficulties include the nitrogen filling necessary for the drying out of the oily parts of the tank and leakage through aged sealings, etc.

The author has had good experience using a drying technique stipulated by Sécheron Ltd., Geneva, Switzerland. The oil filled transformer must first be lagged with awnings and cushions and then evacuated. Using an oil treatment installation, the oil is heated to 80 to 90°C and circulated. Then, while still evacuated and heated, the oil volume is reduced to one quarter of its original volume. The oil itself is then dried out.

### Application of Vacuum in the Drying And Degassing of High Tension Cables

*By G. Martin, pp. 774-777. Original title: L'emploi du vide dans le séchage et le dégazage des câbles à haute tension. G. Martin is with S.A. bâbleries et Tréfileries de bossonay, bossonay-Gare (VD), Switzerland.*

The author gives a very good review of the problem and modern techniques without, however, giving much new information for a specialist in this field. In the discussions on the papers, some interesting contributions were given.

*L. Erhart (Sprecher and Schuh A. G., Aarau, Switzerland):* In the case of high voltage measuring transformers it is difficult to dry and evacuate the normal thick paper insulation. A suitable technique is now known but it is still not certain how great a reduction in the residual moisture is necessary when vacuum drying is used. The author found that a moisture content of $8 \times 12^{-2}\%$ weight in paper and 5 ppmin oil gives the best results electrically and is also economical. For technical and economic reasons the residual pressure in the oven must be a power of 10 lower to reach the necessary $2 \times 10^{-2}$ Torr. in paper and $10^{-1}$ Torr. in oil.

*News about* R&A SINCE 1913 **Adhesives**

**FOR ALL METALS AND ALL PLASTICS**

# NEW LOW-COST, ONE-TO-ONE-MIX EPOXY FEATURES

## Bondmaster® M666

An easy-to-handle, "equal mix" (by volume), 100%-reactive, two-part formulated epoxy adhesive which produces high-strength bonds between practically any materials. Coated parts may be mated without delay to cure at room temperature, require only enough pressure to keep them in intimate contact during cure.

Fully cured bonds exhibit minimal shrinkage, are electrical insulators, and provide excellent resistance to weather, galvanic action, and most chemicals, acids, and alkalies.

BONDMASTER M666 has been found to be particularly effective for the bonding of the following materials:

**aluminum • magnesium • copper • brass • bronze • cast iron • zinc • steel • stainless steel • Alnico magnets • ceramics • carbides • glass • graphite • treated Teflon • rigid plastics • heat-resistant rigid plastic foams • structural laminates • Foamglas • asbestos board • honeycomb sandwich panels • decorative laminates • wood • hardboard • particle board • and many other materials and surfaces.**

**SPECIAL NOTE ON COSTS FOR VALUE ANALYSIS PERSONNEL**

Aside from the lower labor and equipment costs resulting from the use of a 1:1 mix, BONDMASTER M666, itself, is priced at ⅓ to ½ less than most conventional formulations of equivalent strength.

**In mass production panel bonding applications, for example, the cost per square foot of completed glue line with this 100%-reactive epoxy is equal to or less than that achieved with most solvent-dispersed "contact bond" types.**

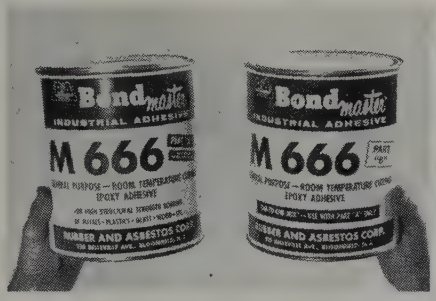
Add to this the many advantages that epoxies offer (one surface application; no ovens, no lamps; no nip rolls; greater reliability, etc.) and you have a new bonding concept that warrants prompt evaluation!

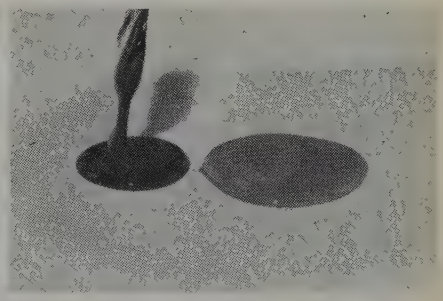
R&A SINCE 1913

**RUBBER & ASBESTOS CORPORATION**

**226 BELLEVILLE AVENUE**
**BLOOMFIELD, NEW JERSEY**

- **EQUAL PART MIX BY VOLUME**
- **HIGH STRENGTH**
- **ROOM TEMPERATURE CURE**
- **"COLOR-SIGNALLED" COMPONENT**



**Equal parts by volume . . . one is red, the other amber . . . mix until streaks disappear . . . spread!**

Now *any* workman, *any*where, *every* time can accurately proportion and mix new high-strength BONDMASTER M666 room-temperature-curing epoxy adhesive . . . without scales, without costly "kits", without special equipment.

Just pour out equal parts — by VOLUME — and mix. One part is colored red, the other is clear amber. Mix until the color is uniform — it's ready for use! (No danger of improper mixing — the color gives a clear signal.)

The mixed adhesive is smoothly free-flowing — can be applied with spatula, trowel, paint roller, knife, brush, etc. Here, color gives swift visual check on uniformity of coverage — skipped spots or inadequately coated areas are instantly signalled . . . and corrected.

***Print Ins. 8 on Reader Service Card***

**HIGH STRENGTH — NO FOAM ATTACK**

BONDMASTER M666 is 100% reactive; undegraded; formulated for *industrial* use — do not confuse with "filled" household products. Fully cured metal-to-metal bonds, tested at r.t. using MIL-A-5090B procedures, yield up to 3,500 psi. Bonds involving expanded 'styrene foam withstand 175°F for 200 hours without cell attack.

**WRITE FOR FURTHER DATA**

If you are now using ANY two-part room-temperature-curing system, it will pay you to investigate the lower labor and material costs . . . and high strength . . . attainable with BONDMASTER M666. If you've been hesitant about using epoxies, here's a "foolproof" adhesive that *any* employee can now handle without problems.

A lower degassing pressure causes destruction of the oil. If a greater reduction in the moisture content of the paper is necessary, it can only be attained if the air sealing is trustworthy.

*H. Hartmann (Chief Engineer, A. G. Brown Boveri, Baden, Switzerland)* pointed out that it is very important that the evacuation process should not be interrupted. If this should happen due to a leakage, for instance, another full treatment is necessary. He referred also to the importance of the use of vacuum drying in connection with measuring transformers encapsulated in molded resin.

*Gino Beer (Ansaldo-San Giorgio, Genoa, Italy).* This company produces vacuum pumps with a capacity of 3000-6000 cubic meters per hour and an oil treatment installation with a capacity of 1900 liters per hour leaving the oil with a residual moisture content of 1.5 gram per ton (European) of oil.

The transformers are evacuated in their own tanks and reckoning on leakages from $10^{-1}$ Torr./liter/sec. to 1 Torr./liter/sec., a final vacuum of $4\times7\times10^{-2}$ can be so reached. A final vacuum of $10^{-1}$ gives no important improvement in the values of tan δ and the insulation resistivity. The values of tan δ give a good check on the drying process when applied to paper insulation and "Bakelite" cylinders.

Experience shows that in spite of the tan δ and insulation resistance remaining constant during a certain time of the drying period, the drying is still not complete. It is important to check the condensed water volume coming out of the insulation. In the author's company, it is the normal practice to stop the drying process if, in one day, only 100 grams of water per ton of paper or presspan are condensed. From tests on models it is assumed that at a copper temperature of 100°C and a final vacuum of $4\times10^{-2}$ Torr., the moisture content of the dielectric is less than 0.2%.

*Dr. K. Michel (A. G. Brown Boveri, Baden, Switzerland)* presented results obtained on models of traction motor coils. Measurements of heat transfer were made on different insulation systems. A vacuum molded epoxy resin insulation gave the best results and impregnants containing solvents gave poor results. The addition of mica also gave poor results.

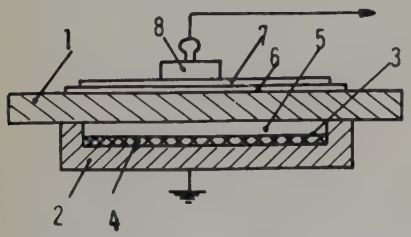



*Figure 1, cell for the testing of insulating varnish films under corona conditions. 1) Glassplate 350x350x6 mm, 2) Steel housing, 3) Varnish film 0.05 ± 0.005 mm, 4) Steel plate 1.5-1.6 mm, 5) Air space, 6) Conductive paint, 7) Conductive foil, and 8) Electrode.*

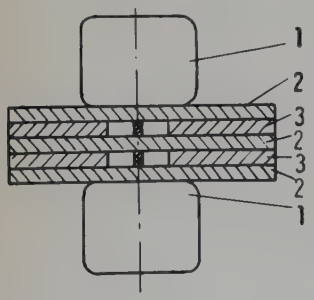



*Figure 2, cell for the testing of insulating materials under corona. 1) Steel electrodes 40 mm diameter, 2) The test specimen, and 3) Spacers to make "holes in the sample."*


*Figure 3, model for testing insulating materials under corona conditions. 1) Brass tube 20 mm dia, 500 mm long, 2) The testing material wound 1 mm thick, and 3) Electrode 150 mm long.*

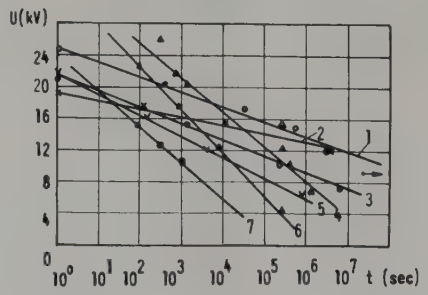



*Figure 4, life curves of tested models for different materials at 120°C. The points are mean values from between 4-5 measurements. Time in sec. until breakdown at a known fixed voltage. 1) Mica insulation, 2) Silicone rubber-glass cloth-varnish, 3) Glass cloth varnish LSK-7, 4) Glass cloth varnish LSE 1, 5) Glass cloth varnish LST TSCH, 6) Triacetate film, and 7) Varnished cotton tape.*

### The 'Thermalastic' Process as Used in the Insulation of High Voltage Electrical Machines

*By E. Boogaerts in the ACEC Revue No. 2, 1961 pp. 20-30. Original title: Le procédé 'Thermalastic' dans l'isolation des machines électriques à haute tension.*

The firm Ateliers de Constructions Electriques de Charleroi, France are licensees of Westinghouse, USA. Here in their own journal they give a very good account of this well known American insulation system. The paper contains illustrations showing the fabrication process and curves showing the important properties of the system. Since 1954, ACEC have used this system successfully for all their large rotating machines.

### Different Methods of Determining the Corona Resistivity of Electrical Materials

*By N. W. Aleksandrov, E. A. Kalinina, S. G. Trubacev in Elektritschestwo No. 4, 1961 pp. 61-68. Original title: Opredelenje koronostojkosti elektroizolacionik materialov rozlicnimi methodami. The authors are with the Lenin Institute.*

This article published in Russian is a typical example of the research methods used in the communist part of the world. A thorough study of all the literature available on the subject plays an important part and in the first part of the paper the authors give a résumé of opinions, experiences, and test methods published in literature throughout the world. Conclusions as a result of this study are as follows:—

It is important to know the corona onset voltage and the resistance of

# Protect space-traveling cables against heat, moisture and abrasion with J-M Teflon*-Coated Fiber Glass Yarn

Teflon-coated J-M Fiber Glass Yarn was especially developed to protect the various types of electrical wires, cables, sleeving and lacing cord used in aircraft, rockets and missiles.

In critical service conditions, its protective performance is outstanding. Here are its most important advantages:

- Maximum abrasion resistance
- Greater flex life . . . because each strand is coated and separate from adjacent strands
- Unusually high moisture resistance
- Performs at temperatures ranging from 500 F. to minus 100 F.
- High resistance to dielectric breakdown
- Highly resistant to effects of weathering
- Chemically, virtually inert
- Low surface coefficient of friction

After braiding onto wire or cable, the covering is sintered by the manufacturer at about 650 F., causing a slight flow of the Teflon—just enough to bond it with adjacent strands for an unbroken Teflon coating.

J-M Fiber Glass Yarn is coated with 12% or 15% Teflon, or to meet your specifications. It is available in these sizes: 450-1/2 . . . 225-1/2 . . . 150-1/2 . . . 150-1/3 . . . and 150-2/2. The yarn is supplied in plied constructions on multiple-end wound braider and serving packages for use with standard braiding equipment.

For more details, call your Johns-Manville Representative. Or write J. B. Jobe, Vice President, Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ont.

*Registered trademark of the Du Pont Company for tetrafluoroethylene resin.*

JOHNS-MANVILLE FIBER GLASS

JOHNS-MANVILLE JM PRODUCTS

**Print Ins. 9 on Reader Service Card**

the material against corona. The influence of corona on the stressed material can be direct, causing a decrease in the breakdown voltage as a result of the electron bombardment, or indirect, causing chemical destruction. Two classical test cells are known as the French cell and a U.S. IEC proposal. (The authors seem to ignore the very interesting work of Mr. Mason, England.)

*Tests on insulating varnishes*

In the closed test cell shown in figure 1, a varnish film $0.05 \pm 0.001$ mm was corona tested for 1 to 12 hours. The field strength in the air space between the glass plate and the varnish film was about 3.5 kv/mm. To control the aging; tan $\delta$, the specific resistivity of the insulation, and the breakdown voltage were measured as a function of the aging time. However, since no definite results or indications of the corona resistivity were obtained using this method, a new test using varnish films 0.5 mm thick was carried out. The loss of weight during the aging time was measured but once again no definite results were obtained.

*Tests on insulating materials*

Two different tests are described, one using a cell (figure 2) and the other using a model (figure 3). In both cases the breakdown was measured as a function of the time during which the voltage was applied and the field strength on different materials of various thicknesses. (As an example see figure 4.)

These tests and the varnish tests are carried out in a surprisingly short time. In Europe and America, high frequency techniques are used to shorten the aging time but in spite of this the usual aging time is measured in months. It is believed however that some new General Electric Co. tests are moving in this Russian direction.

The authors concluded that mica is still the best insulation and should be included in all highly electrically stressed insulation systems. Materials exist having a higher 1-minute electrical strength but the rate of decrease as a function of aging time greatly exceeds that of mica insulations.

Tests were carried out at 120°C and it was found that the deterioration which took place under corona was greater than that under temperature stress alone.

The authors used the formula

$$U = A - n \log T$$

to express the life curves of the materials where

$U$ = applied voltage

$T$ = aging or life expectancy

$A$ = breakdown voltage for a short time test (voltage rise 1 kv/sec.)

$n$ = coefficient of the material.

In the paper a table is given showing values obtained for these factors.

The authors conclusions are as follows:

1) tan $\delta$ gives no indication of the rate of deterioration of a material subject to corona stress.
2) 1 minute tests also give no indication of the life expectancy of the material.
3) The life curves give the best indication of the corona resistivity as long as they are not the result of thermal breakdown.

# *Industry News*

Construction has begun on an additional 175,000 sq ft of floor space for the *Radio Corp. of America's* Burlington (Mass.) plant.

*Robins Industries Corp.* has moved to new quarters in College Point, Flushing, N.Y.

*Dulon Inc.*, manufacturer of insulated wire and cable and insulating tapes, has built a new plant in Holbrook, N.Y.

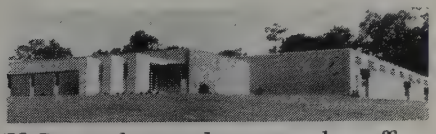
*Cary Chemicals Inc.*, East Brunswick, N.J., plans to build a new 100-million pounds per year polyvinyl chloride plant on the Delaware River just west of Burlington, N.J.

*Cornwell Electronics Corp.*, Byram, Conn., has been acquired by *Instrument Systems Corp.*, College Point, N.Y.

A new corporation, *Jet Stream Products Inc.*, has been jointly formed by *Chance Vought Corp.*, Dallas, and *International Textile Maintenance Equipment Corp.*, Reno, Nev., to produce a new type of commercial laundering machine.

*Polyply Inc.* has purchased the Reinforced Plastics Division (both Amsterdam, N.Y.) of Fiber Glass Industries Inc.

*Dixon Corp.* recently completed a 25,000 sq ft building in Monroe,



N.C., to be used as a sales office, fabricating plant, and warehouse for fluorocarbon products.

*Mica Corp.*, Culver City, Calif., has appointed the following companies to sell its epoxy reinforced laminates: *Daniels & Goepp Co.*, San Francisco, Calif.; *C. P. Waggoner Sales Co. Inc.*, Grand Prairie, Texas; *Empire Products Inc.*, Englewood, Colo.; and *Burcaw-Cowan Co.*, Detroit, Mich.

*Shawinigan Resins Corp.*, Springfield, Mass., has named *The Breffeilh Co.*, New Orleans, to sell its polyvinyl resins and emulsions in Mississippi, Alabama, and Florida.

All of the outstanding stock of *Cole Rubber and Plastics Inc.*, Palo Alto, Calif., has been acquired by *Plastics Corp. of America Inc.*, Minneapolis. A new plant will be built for Cole in Santa Cruz, Calif., in which Cole will make silicone and fluorocarbon products.

*Tri-Point of New England Inc.*, Warwick, R.I., a newly formed subsidiary of *Tri-Point Industries Inc.*, is now producing "Teflon" tape and film.

Agents selected to handle *General Electric's* insulation testing equipment are: *Electro-Tech Equipment Co.*, New York; *Gordon Yale Associates*, Boston; *Sunshine Scientific Instruments*, Philadelphia; *Wadsworth Manufacturing Associates*, Liverpool (Syracuse), N.Y.; *Christie Laboratories*, Cleveland; and *Excel Electric Service Co.*, Chicago.

*Tech-Art Plastics Co.*, Morristown, N.J., custom molder of plastics, has been acquired by *Pratt, Read & Co. Inc.*, Ivoryton, Conn.

A new corporation, *Molecular Dielectrics Inc.*, has been formed through the consolidation of *Electronic Mechanics Inc.*, Clifton, N.J.; *Mykroy Inc.*, Chicago; and *Mykroy Mfg. Co. Inc.*, Andover, N.J. Delbert E. Replogle is president. Company will manufacture man-made mica and mold and fabricate glass-bonded mica and other mica and ceramoplastic insulating products.

*CP Electronics* (formerly *Columbus Process Co.*), Columbus, Ind., has relocated its advanced product planning and research laboratory to a site near Purdue University, West Lafayette, Ind.

A new plant for the manufacture of aluminum magnet wire is now being constructed in Ft. Wayne, Ind., by *Rea Magnet Wire Co. Inc.*, subsidiary of *Aluminum Co. of America.*

*Miller-Stephenson Chemical Co. Inc.* has moved to larger facilities in Danbury, Conn.

# People in the News

*Carl E. Barnes*, Minnesota Mining and Manufacturing Co., to vice president for research, FMC Corp., New York City.

*C. E. Barnes*

*S. J. Trykowski*

*Stanley J. Trykowski*, Electronic Rubber and Plastics, Stamford, Conn., to technical director, The Blane Corp., Canton, Mass. *Sumner Levin* to manager of Blane plant operations.

*Walter J. Plate*, manager, Cable Accessories Div., Anaconda Wire and Cable Co., to manager, rubber and plastic specification products.

*Russell T. Dean* to chief engineer, resistor engineering department, Stackpole Carbon Co., St. Marys, Pa.

*Robert L. Hurley*, sales vice president, Advanced Vacuum Products Inc., to marketing vice president, National Beryllia Corp., Haskell, N.J.

*R. L. Hurley*

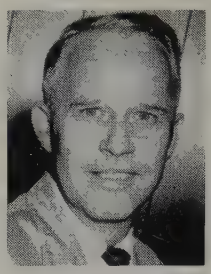
*W. W. Smith*

*W. W. Smith*, chief of engineering development to vice president of engineering, Babcock Electronics Corp., Costa Mesa, Calif.

Allis-Chalmers Manufacturing Co., Milwaukee: *Gordon W. Clothier*, manager of motor and generator department to manager of transformer planning, Power Equipment Div.: *Walter L. Peterson*, assistant manager to manager, motor and generator department; *Daniel F. McNulty* to application engineer, control department, Industries Group; *Eugene M. Underwood*, to assistant engineer, power systems engineering.

*Harry B. Beisswenger* to New York district manager, Hull Corp., Hatboro, Pa.

*A. J. Rouse*, Synthane Corp., Milwaukee sales staff to St. Louis. *David Garrison* to Philadelphia district sales manager.



*D. Garrison*

*J. Holecek*

*Jerry G. Holecek*, Holex Polymer Products Inc., Queens, N.Y., to director of plastics research, Anchor Alloys Inc., Brooklyn, N. Y.

*John J. Moran*, vice president, Sigma Instruments Inc., S. Braintree, Mass., to executive vice president.

*Paul F. Allmendinger*, Stewart-Warner Corp., Chicago, to director of engineering, electrical products group, The Electric Autolite Co., Toledo, Ohio.

*Roy S. Williamson*, Remington Rand Univac, to sales manager, upper midwest district, Rockbestos Wire & Cable Co. Div., Cerro Corp. *Jerome H. Fuchs* to executive assistant to the president, Rockbestos.

*R. Williamson*

*J. H. Fuchs*

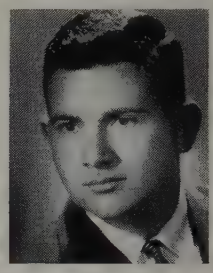
*Peter M. Maler*, general manager, Skottie Electronics Inc., Peckville, Pa., to vice president in charge of manufacturing for Astron Corp., East Newark, N.J., and its subsidiaries, Skottie Electronics and Minitronics Corp.

*George D. Gammell*, Northern States Power Co., and *Piedmond Lippand* to engineers, Automatic Controls Div., Electro Nuclear Systems Corp., Minneapolis, Minn.

*Richard A. O'Brien* to supervisor of reliability and military products, Corning Glass Works, Bradford, Pa. *Raoul J. Casciari* to manager of product development, Electrical Products Div.

*John N. Vogt*, General Electric Co., to vice president in charge of manufacturing, Temperature Engineering Corp., Riverton, N.J.

*J. N. Vogt*



*J. Venerus*

*Joseph Venerus*, senior ceramics engineer to project engineer—ferrites, General Ceramics Div., Indiana General Corp., Keasbey, N.J.

*James A. Donnelly* to California sales representative, Alva Allen Industries, Clinton, Mo.

*Michael Pisetzner*, plant manager to general manager, Electro-Technical Products Div., Sun Chemical Corp., Nutley, N.J.

*Joe F. Pitt*, Douglas Aircraft, Tulsa, Okla., to southeast district sales manager, Coast Pro-Seal & Mfg. Co., Atlanta, Ga.

*Jerome Formo*, Minneapolis-Honeywell Regulator Co., to vice president and director, Plastics Corp. of America Inc., Minneapolis; *Richard H. Hall*, Deutsch Molding Corp., to southern California sales for PCA's West Coast subsidiary, Cole Rubber and Plastics Co.

Sylvania Electric Products Inc., subsidiary of General Telephone & Electronics Corp.: *David K. Elwell*

# BAKELITE® POLYETHYLENE HELPS POWER AN ISLAND... underwater cable stands up under 100% overloads!


Termination of power cable insulated and jacketed with BAKELITE polyethylene in a powerhouse cubicle on the mainland.

So. CHARLESTON, W. VA.: In 1956, Union Carbide Chemicals Company found an easy solution to bringing electric power from the mainland to Blaine Island. The submarine carrier: a single 15-KV load transfer cable, insulated and jacketed with durable BAKELITE polyethylene, laid along the bottom of a channel . . . without additional shielding.

Although continuously exposed to severe physical and chemical tests, the BAKELITE insulated-jacketed cable has provided failure-free 'round-the-clock power . . . despite wide load variations. Even a recorded 100% overload lasting several seconds didn't interrupt service or damage the cable.

When you have a power cable problem, it makes good sense to choose cable insulated and jacketed with BAKELITE polyethylene. Tough, durable, highly resistant to moisture and cracking, and an excellent low-loss dielectric, BAKELITE polyethylene is designed to provide optimum performance under severe conditions. Flexible and light in weight, polyethylene insulated-jacketed cables are easy to install, require no protective ducts or conduits.

*Want more information?* Write Union Carbide Plastics Company, Division of Union Carbide Corporation, Dept. KL-75L, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Limited, Toronto 12.

UNION CARBIDE **PLASTICS**

BAKELITE and UNION CARBIDE are registered trade marks of Union Carbide Corporation.

***Print Ins. 13 on Reader Service Card***

to director of purchases; *Merle W. Kremer* to vice president, Electronic Tube Div. (he continues as vice president and general manager, Parts Div.); *William J. Perry* to director and *Frank E. Butterfield* to chief engineer, Electronic Defense Laboratories; *Maxwell C. Scott* to manager, conversion and manufacturing, Mountain View (Calif.) Operations; *Arne Schleimann-Jensen* to manager of product engineering, Microwave Device Operations; *Guy Black* to staff engineering specialist—development planning for Sylvania Electronic Systems; *John B. Donner* to manager, microwave and antenna laboratory, Waltham (Mass.) Laboratories.

*William A. Wildhack*, special assistant to the director, National Bureau of Standards, to associate director.

*George A. F. Schulte* to Florida sales representative for the Seiberling Rubber Co., Plastics Div., Newcomerstown, Ohio. *W. Horace Mason*, president and general manager of Seiberling Rubber Co. of Canada Ltd., also elected vice president and treasurer of the parent Seiberling organization in Akron, Ohio.

*W. Mason*

*R. Simpson*

*Robert M. Simpson*, Columbia-Southern Chemical Corp., to marketing and sales manager, Ram Chemicals Manufacturing Co. Inc., Gardena, Calif.

*Neil E. Billman*, laminated products sales in Los Angeles, to East Central District silicones sales. Oak Park, Mich., General Electric Co.

New vice presidents for Sigma Instruments Inc., South Braintree, Mass., are: *Ralph S. Thompson*, manufacturing; and *Robert H. Pierce*, engineering.

*Jerome I. Cohn*, Inso Electronic Products Inc., to director of sales engineering, Radiation Materials Inc., Long Island City, N.Y.

*Freeman F. Desmond*, Burndy Corp., to Eastern Region sales manager, Times Wire & Cable Div., The International Silver Co., Wallingford, Conn.

*W. Vernon Davey* has been elected president and treasurer of The Dano Electric Co., Winsted, Conn. *Harold D. Sisson* succeeds Davey as vice president.

*L. Edward McGlaughlin*, to manager of new central sales office (Chicago) for Dodge Fibers' Corp., Hoosick Falls, N.Y.

*L. McGlaughlin*

*D. Palamountain*

*David Palamountain*, Raytheon Manufacturing Co., to director of quality control, Aerovox Corp., New Bedford, Mass.

# Association News

### Naef Named AIEE Fellow For Arc and Insulation Work

Otto Naef, consultant to the American Electric Power Service Corporation, has been given the rank of Fellow by the American Institute of Electrical Engineers for contributions in the fields of arc extinction and insulation co-ordination which contributed to successful design of high voltage power systems, especially for extra high voltage circuit breakers.

### New Officers and International Award for SPE

James R. Lampman, General Electric Co., has been elected 1962 president of the Society of Plastics Engineers. Other new officers are: John M. Berutich, Haveg Industries Inc., vice president, engineering; Richard B. Bishop, Holy Cross College, vice president, administration; George P. Kovach, Foster Grant Co. Inc., secretary; and Samuel H. Greenwood Jr., F. J. Stokes Corp., treasurer.

The five will take office on January 31 at the society's annual meeting and technical conference (January 30-February 2) in Pittsburgh, Pa.

The society has also established an International Award for fundamental contributions in plastics science and

engineering which will be presented for the first time at the technical conference. It includes a cash honorarium of $1000.

### Manufacturing Engineering Council Names New Officers and Directors

At a recent national meeting of the Manufacturing Engineering Council, officers and directors were elected for the 1961-62 term of office. Those named were the following: President—Harry Hibler, Designers for Industry Inc.; Vice President—Walter A. Stadtler, IBM Corp.; Treasurer—Frederick I. Ellin, Ohmite Manufacturing Co.; Directors—Roger W. Bolz, Automation; William C. Leone, Rheem Manufacturing Co.; Milton Nielsen, Booz Allen Applied Research; Murray Braid, Thompson Ramo Wooldridge Inc.; Joseph E DuQuette, Magnovox Co.

### Plant Engineering and Maintenance Show and Conference

Management techniques will be featured at the Plant Engineering and Maintenance Conference at the Convention Hall, Philadelphia, January 22-25. More than 400 companies will show their products in a record-breaking exhibit area.

### IPCEA Names Driscoll President, Lists New Temperature Definitions

E. G. Driscoll, Phelps Dodge Copper Products Corp., has been elected president of the Insulated Power Cable Engineers Association.

The IPCEA has also just released three definitions covering maximum temperature of conductors which may be used for the determination of ampacities of insulated wire and cable. They are:

1) *Maximum Conductor Temperature —Operating.* The highest conductor temperature attained by any part of the cable line under operating current load.

2) *Maximum Conductor Temperature —Emergency Overload.* The highest conductor temperature attained by any part of the cable line during emergency overload of specified time, magnitude, and frequency of application.

3) *Maximum Conductor Temperature —Short Circuit.* The highest conductor temperature attained by any part of the cable line during a short-circuit of specified time and magnitude.

### Gay Named ASA Managing Director

Roger E. Gay, management consultant, will succeed Vice Admiral George F. Hussey, Jr. USN (Ret), as managing director of the American Standards Association effective January 1962.

# *New Publications*

### Books

*Handbook Preferred Circuits*, Navy Aeronautical Equipment, NAVWEPS 16-1-519, Supplement No. 4. Contains four new transistor circuits, and revises five of the vacuum tube circuits to include data for the use of subminiature tubes. 48 pages, 35 cents. Order from Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

*ASTM Proceedings*, Volume 60. Official record of the 1960 proceedings of the American Society for Testing and Materials. 1242 pages, $12. ASTM, 1916 Race St., Philadelphia 3, Pa.

*ASTM Standards on Plastics D-20*, 12th edition. Supersedes the 11th edition published December 1959, and contains 25 new standards and 29 revisions. Hard cover, 1222+ pages, $10. ASTM, 1916 Race St., Philadelphia 3, Pa.

*The Condensed Chemical Dictionary*, edited by Arthur and Elizabeth Rose. Revised sixth edition contains thousands of new entries, including the elements discovered as recently as June 1961, and a greatly expanded description of uses and derivations. Hard cover, 1,277 pages, 6⅝″ x 9¾″, $17.50. Reinhold Publishing Corp., 430 Park Ave., New York 22.

*Handbook of Electronic Charts and Nomographs*, by Allan Lytel. Contains 58 electronic charts and nomographs and a clear vinyl overlay sheet for ruling in erasible lines. 256 pages, 8½″ x 11″, $4.95. Howard W. Sams & Co. Inc., 1720 East 38th St., Indianapolis 6, Ind.

*National Fire Code, Volume V (Electrical)*. Includes a new manual on static electricity. 814 pages, $7. Publications Dept., National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

*NFPA No. 77M, Static Electricity*. Newly revised publication on controlling fire hazards of static electricity. 60 pages, $1. National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass.

*Electronic Equipment Design and Construction*, by Geoffrey W. A. Dummer, Cledo Brunetti, and Low K. Lee. 238 pages plus index, 47 illustrations, 6″ x 9″, $8.50. McGraw-Hill Book Co., 330 W. 42nd St., New York 36.

### NEMA Publications

The following new and revised publications may be obtained from The National Electrical Manufacturers Association, 155 East 44th St., New York 17.

LI 3-1961, *High-Temperature Properties of Industrial Thermosetting Laminates*. Covers high-temperature work done since 1959 on the flexural and dielectric strength of grade XXXP, LE, G-5, G-7, G-11, and GPO-1 laminates. 35 cents.

VF 9-1961, *Varnished Polyester Non-Woven Fabric*. Covers ordering information, methods of test, dimensions, physical and electrical properties, manufacture, packing, marking, and inspection of yellow and black fabrics used as electrical insulation. 25 cents.

WC 5-1961, *Thermoplastic-Insulated Wire and Cable*. This book describes conductors, grades of insulation, protective coverings, and constructional and dimensional details common to most thermoplastic-insulated wires and cables in the range of 0 to 15,000 v. $3.50.

WC 30-1961, *Color Coding of Wires and Cables*. Covers asbestos-insulated range wire, flexible cords, and wires and cables insulated with rubber, thermoplastic compounds, asbestos, asbestos-varnished cloth, and asbestos-thermoplastic insulation. 35 cents.

WD 1-1961, *American Standard Outlet Receptacles, Attachment Plug Caps and Appliance Plugs*. Deals with configurations and dimensions of 125 v, 125/250 v, 250 v, 277 v, midget-locking-type, and locking-type caps and receptacles and of appliance plugs and receptacles. $1.50.

## *Largest "Teflon" Molding*

A 210-pound tube of solid Teflon, believed to be the largest Teflon billet that has ever been produced for any purpose, has been molded by the Plastic Products Div., Raybestos-Manhattan Inc., Manheim, Pa. The giant tube (shown under X-ray machine in photo), developed for proto-

type work on a classified missile project now underway, has a 5-inch inside diameter, 12-inch outside diameter, and is 24 inches long. The billet is part of a three-piece set which also includes two large Teflon molded rods, all of which were produced in duplicate, and will subsequently be machined to final dimensions. Total weight of the three pieces in each set is approximately 340 pounds. Special processing was necessary during manufacture to prevent stresses and then each unit was X-rayed to be certain there were no internal voids or fractures. Generally thought of as slippery, tough, moisture- and chemical-resistant, Teflon was specified for the new missile project mainly because of its excellent ablative and dielectric properties.

## *Black Void Reactor Concept*

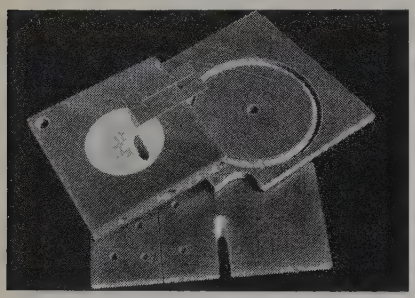
A promising concept in reactor design has been studied at the National Bureau of Standards. This concept, the Black Void Reactor, would provide spatially separated fast and slow neutron fluxes simultaneously, thereby permitting radiation effects studies and thermal neutron beam studies to be conducted independently. In addition, this arrangement constitutes a type of flux trap (inverted) which yields higher fluxes for a given power input than does the usual research reactor. Several reactor types under development by the Atomic Energy Commission may contribute knowledge to this concept.

# *New Materials and Components*

*For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card—no postage is required.* Insulation *will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.*

### *Asbestos-Polyester Laminate for 155-180°C*

A new purified asbestos paper-polyester resin electrical laminate is said to be far stronger both electrically and mechanically than any NEMA grade A or AA laminate made. Called "Quinterrabord" No. 880, it is recommended for applications to 50 kv at temperatures in the 155 to 180°C

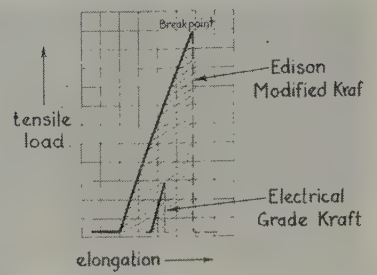


range. Other features cited include: thermal reliability; retention of high dielectric strength over long periods of time when exposed to high temperatures and humidities; easy fabrication; high chemical and fire resistance; and about twice the arc resistance of glass-polyester laminates. A density of 110 lbs/sq ft, a perpendicular dielectric strength of 350 vpm (1/16″), and a tensile strength of 30,000 psi (1/16″) are reported. Johns-Manville, 22 East 40th St., New York 16.

***Print No. Ins. 101 on Reader Service Card***

### *Tougher Transformer Insulating Paper With Better Thermal Stability*

Modified kraft paper insulation for use in transformers is said to have greatly improved thermal stability to permit higher temperature operation. Toughness, tensile, tear, and burst strength properties are all stated to




show significant improvement over electrical grade kraft under accelerated aging conditions in oil. Thomas A. Edison Research Laboratory Div., McGraw-Edison Co., West Orange, N.J.

***Print No. Ins. 102 on Reader Service Card***

### *High Purity Synthetic Rubber For Electrical Insulation*

Four new special grade synthetic rubbers designed for electrical applications and end products requiring high purity have been added to a line of "Plioflex" styrene-butadiene rubbers (SBR). Excellent resistance to water or moisture absorption in addition to good electrical properties are the chief characteristics reported. Typical applications include light colored molded and extruded mechanical goods for electrical service and wire and cable insulation. Chemical Div., Goodyear Tire & Rubber Co., 1144 E. Market St., Akron 16, Ohio.

***Print No. Ins. 103 on Reader Service Card***

### *Flame Resistant DAP Molding Compound*

New diallyl phthalate molding compound reportedly offers exceptional flame resistance, ultra-high strength, electrical properties, and heat resistance. The Acme 3-2-530 compound is manufactured to comply with Mil-M-19833, type GDI-30F. It is also specifically designed to meet the requirements for new barrier-type terminal boards, as outlined in specification Mil-T-16784 which is now being revised. Formulated with long glass fibers and heat resistant DAP polymers, it is claimed to provide new high levels of tensile, flexural, and impact strengths, plus retention of essential properties at higher temperatures. Data sheet and samples available. Acme Resin Corp., 1401 Circle Ave., Forest Park, Ill.

***Print No. Ins. 104 on Reader Service Card***

### *Flexible Acrylic Sleeving For Class B Insulations*

New class B (130°C) insulating material, "Hygrade" AC-761 acrylic coated fiber glass sleeving, reportedly retains good flexibility on heat aging at rated temperature, and has indefinite shelf flexibility. It is compatible with acrylic, epoxy, polyester, phenolic, and "Formvar," and is non-corrosive to conductor wire. Excellent electrical characteristics and outstanding oil and cut-through resistance are also claimed. Brochure available. L. Frank Markel & Sons, Norristown, Pa.

***Print No. Ins. 105 on Reader Service Card***

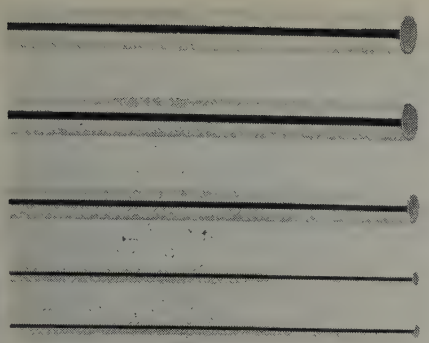
### *Stable One-Part Epoxy Resins*

Convenient, stable, one-can epoxy resin systems that cure at room temperature reportedly are made possible by the development of several types of latent hardeners and catalysts, called Chemical-Loaded Molecular Sieves. Using these materials, it is claimed that epoxy resin formulators can now convert many two-part epoxy systems into one-part systems that exhibit excellent shelf life, lower exotherms during cure, and cure rates approaching that of the free chemical. In the new method, the active hardener is absorbed and held within the pore structure of Molecular Sieve adsorbents. It is completely isolated from the system since the larger molecules of epoxy resin cannot enter the pores. At the proper time, the "caged" hardener can be released by the application of heat or the introduction of a displacing agent. Molecular Sieve Products Dept., Linde Co., Div. of Union Carbide Corp., 61 E. Park Drive, Tonawanda, N.Y.

***Print No. Ins. 106 on Reader Service Card***

### *Stripes Impregnated in Flexible 'Teflon' Tubing*

Teflon spaghetti tubing is avail-



able with special color coding for identification of leads, wires, and connections. A color stripe is impregnated in contrasting color stripes for practically any system of identification coding. It is said there is no loss of insulating properties. Prices are comparable to regular tubing. Timely Technical Products Inc., 100 Pine St., Verona, N.J.

*Print No. 107 on Reader Service Card*

### Ceramic-to-Metal Components For Nucleonics Applications

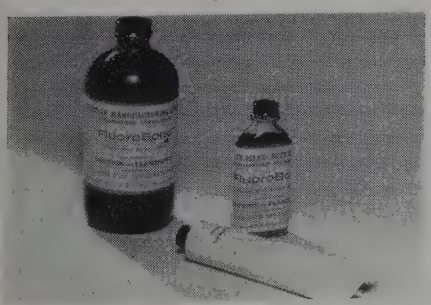
New ceramic-to-metal components for nucleonics applications include motor seals, relay bases, and test components. The motor seals, massive and heavy assemblies made from non-magnetic materials, are designed to carry more than 1,000 amps of current, to withstand internal pressure of 12,000 lbs, and to be disassembled in the field without failure. The relay bases are gold plated 7-pin devices made with a dense alumina insulator 5/8" in diameter. The test components are metalized ceramics used for thin film deposition. Ceramics International Corp., Mahwah, N.J.

*Print No. Ins. 108 on Reader Service Card*

### Etching Solution Makes Fluorocarbons Bondable

Etching "Teflon" or "Kel-F" with "Fluorobond" solution reportedly permits ordinary adhesives to bond these high-temperature plastics to many other materials: glass, ceramics, all fabrics, plastics, rubber elastomers, steel, aluminum, copper, and other metals. Bond strengths as high as 55 lbs/in peel strength are reported, depending upon surface finish and cleanliness. Fluorobond solution is available in 2 oz bottle, $2.85; 3 oz tube, $3.75; pints, $9; quarts, $15; gallons, $45. Joclin Manufacturing Co., Lufbery Ave., Wallingford, Conn.

*Print No. Ins. 109 on Reader Service Card*



*Print Ins. 20 on Reader Service Card for General Electric Co. ad above.*

### Nickel Plated Copper Wire For High Temperatures

Single end copper conductors electroplated with a continuous nonporous coating of pure nickel are available in five standard plating thicknesses. The conductors are gaining wide usage where continuous temperatures between 250°C and 750°C are encountered and where durable unoxidized surface conditions are required. Normally, the wires are used under high temperature insulations such as "Teflon" TFE and ceramic coatings. Ossining Div., Hudson Wire Co., Ossining, N.Y.

*Print No. Ins. 110 on Reader Service Card*

### High Hot Peel Strength Copper-Clad Circuit Laminate

Grade G-10R, a new copper-clad laminate for printed circuitry is said to meet or exceed NEMA and Mil specs for room temperature peel strength and to have high hot peel strength. It is claimed to provide a solution to many wire failures occurring in the soldering operation at 500°F, especially on curved wires which have a tendency to pull off the board. Peel strengths of 9 to 11 lbs/in of width at room temperature and 2 to 4 lbs/in of width at 500°F, using 2 oz copper foil, measured on 1/16" and 1/8" widths are reported. Grade G-10R uses no structural adhesives, meets all specifications of grade G-10, and is offered at no price increase over G-10. Brochure available. Synthane Corp., Oaks, Pa.

*Print No. Ins. 111 on Reader Service Card*

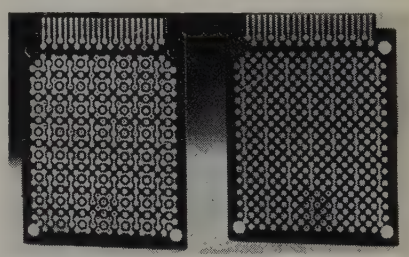
### Laminated Fibreboard for Spacers

New laminated fibreboard consisting of 100% kraft fibres is designed for such uses as spacer sticks in oil-filled transformers. Advantages claimed include controlled compressibility, uniformity, easy fabrication, light weight, low cost, minimum waste, and availability in all thicknesses up to 6". Spaulding Fibre Co. Inc., 310 Wheeler St., Tonawanda, N.Y.

*Print No. Ins. 112 on Reader Service Card*

### Printed Circuit Board for Prototypes and Production

A new "Fotoceram" printed circuit board lets engineers make prototype electronic devices merely by inserting and connecting components. Once a prototype proves successful, the matrix board can also be used for production. No etching or other preparation of the board is required. The matrix board carries a universal ring-and-dot pattern of metallized



runs, pads, and through-plated holes on a base of Fotoceram glass-ceramic. One end of the board is a 22-contact plug section. The board is said to accept all types of components, including transistors. Designed for use in ambient temperatures as high as 250°C, the board reportedly will not warp, bow, sag, swell, rot, delaminate, burn, or absorb moisture, oils, or organic solvents. It is also claimed that the gold-plated copper metallizing will not tear loose or become damaged from repeated soldering. Size of the board is approximately 4½" x 5½" x 1/16". Price is $9.95. Corning Glass Works, Corning Electronic Components, Corning, N.Y.

*Print No. Ins. 113 on Reader Service Card*

### Melamine-Glass Cloth Insulation With High Moisture Resistance

A new melamine-glass cloth laminate, "Lamicoid" 6038E, is stated to have 75% lower moisture absorption than other melamine-glass types. Particularly suited to applications involving high moisture, the new laminate reportedly exceeds the requirements of Mil-P-15037C, type GME; Mil-P-15037B, type GMG; and

# this shows why there's a swing to Anaconda Cement-Coated

The secret's in the bond strength. Anaconda's new 130 C (class B) cement-coated epoxy magnet wire forms a bond so strong that the coil is completely self-supporting.

Cold, it holds its shape perfectly without ties or braces; hot, it can be removed from the oven at 200 C and dipped in encapsulating materials without deforming or losing its shape. Both ways you save on production costs. The cement can be activated by resistance heating, oven heating or solvent.

*The unique Anaconda Epoxy cement coating* makes all the difference. It softens just enough to bond each wire in the coil firmly to adjacent wires. The higher the heat (up to 200 C), the stronger the bond—it is a contact bond with minimum flow.

Because of its *inherent dielectric properties* and because of limited flow, the epoxy cement overcoat actually contributes to the electrical strength of windings. Thus, it is often possible to employ cement-coated epoxy film with little or no increase in over-all diameter of the wire.

*And here are some other advantages:* Anaconda cement-coated epoxy magnet wire won't hydrolize in closed systems because the cement is an epoxy type

**COILS HOLD THEIR SHAPE, WITHOUT SUPPORT, BOTH HOT AND COLD, EVEN AT 200 C.** This 24" diameter coil wound with 18 pounds of #.064x.130CCHEP rectangular magnet wire, is entirely self-supporting because it's made of Anaconda's new cement-coated epoxy magnet wire. The outstanding bond-strength of this wire is stable at high temperatures, too. Coils can be removed from oven and handled while still hot without danger of deforming—as shown in picture below.


# Epoxy Magnet Wire

and the base coat is Anaconda's well-proven epoxy enamel. It is completely compatible with standard transformer oils, varnishes, insulation and encapsulating materials you are most likely to use. It's available in all sizes of round, square and rectangular, packed in spools, reels, pails and drums.

For more information about Anaconda cement-coated epoxy magnet wire, contact Anaconda Wire and Cable Company, 25 Broadway, New York 4, New York, Department EFL-2-I.

ASK THE MAN FROM

**ANACONDA®**

FOR CEMENT-COATED EPOXY MAGNET WIRE 60257

***Print Ins. 21 on Reader Service Card***

NEMA grade G-5. Typical absorption value reported for 1/16" thicknesses is 0.68% (cond. E-1/105, D-24/23). As a result, electrical properties under humid conditions are said to be excellent (for example, arc resistance exceeds 180 seconds under cond. D-48/50). Excellent flame retardance and mechanical properties are claimed. Material is said to be a satisfactory substitute for epoxy-glass

laminates in many class B applications, offering typical cost savings of 15%. Applications include slot wedges, terminal boards, spacer blocks, panels, and end laminations. Mica Insulator Div., Minnesota Mining & Manufacturing Co., Schenectady 1, N.N.Y.

*Print No. Ins. 114 on Reader Service Card*

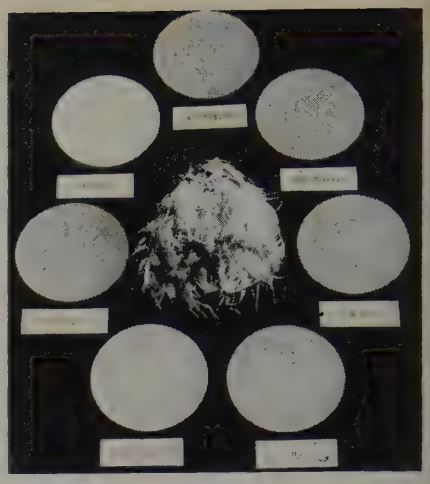
### *Three-Ply Laminate of Polyester Film And Epoxy Varnished Glass Cloth*

A new epoxy laminate consists of a flexible three-ply combination of 5-mil or 2-mil polyester film sandwiched between two layers of 5-mil epoxy varnished glass cloth. The class B insulating material was developed for phase and slot cell insulation. A dielectric strength of more than 1000 vpm, mechanical strength, good crease characteristics, and resistance to chemical attack are reported. Westinghouse Electric Corp., Micarta Div., Trafford, Pa.

*Print No. Ins. 115 on Reader Service Card*

### *Chemical-Resistant Molding Compound For Electrical Insulating at 130°C*

New compound of fiber glass reinforced polyester for molding parts is stated to combine superior electrical insulating properties and good resistance to alkalies, solvents, oxidation, and reduction. Designed for use in apparatus operating at 130°C continuous, components produced with grade 1703-A compound reportedly feature excellent dielectric strength (more than 400 vpm in test specimens), excellent thermal stability,



and high corona starting voltages. Data giving electrical and physical properties as well as reaction to 23 reagents, plus samples, available. The Glastic Corp., Molding Materials Div., 4321 Glenridge Road, Cleveland 21, Ohio.

*Print No. Ins. 116 on Reader Service Card*

### *Epoxy Diluent Reduces Viscosity Of Liquids, Improves End Properties*

A new epoxy diluent, agent AT-534, is described as a low-cost ($.45/lb), non-toxic epoxy reactive diluent which effectively reduces the viscosity of liquid epoxy systems and thereby contributes many formulating and end-property advantages, such as improved impact resistance. This high-boiling, odorless liquid reportedly reacts readily with epoxy-curing agent admixtures without any appreciable effect on the rate of cure or gel, even at room temperatures. It does not react with the epoxy resin in the absence of a curing agent, and permits long storage under normal conditions. Data Sheet TA-69 available. Acetylene Chemicals Dept., Antara Chemicals Div., General Aniline & Film Corp., 435 Hudson St., New York 14.

*Print No. Ins. 117 on Reader Service Card*

### *Epoxy Resins with Higher Functionality*

New series of polyepoxide resins—designated KER resins—permit resin formulators and users to vary the properties of end products to a greater degree than was previously possible. The resins are derived from an ortho-cresol-formaldehyde novolak which is then reacted with epichlorohydrin to form a polyepoxide. Functionality of from 2.5 to 5.5, shorter cure, im-

# THERE ARE JOB-ENGINEERED DIFFERENCES IN EVERY CLASS OF

# ESSEX

## FILM COATED magnet wire

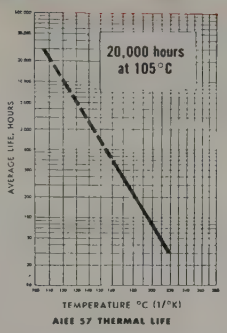
There's a "right-wire" for you in this full Essex line. Each one has job engineered differences specifically developed for your applications. Selecting the proper Essex magnet wire will assure you of greater efficiency . . . with minimum trouble and down time. Some of the differences and applications are typified in the examples given below.

| Enamel | Formvar | Acrylic | Modified Formvar | Self-Bonding Formvar | Nylon | Formvar-Nylon Comb. | Urethane | Non Slipping Urethane | Urethane-Nylon Comb. | Self-Bonding Urethane | Epoxy | Mod. Polyester | Silicone | ML* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class 105C | Class 105C | Class 105C | Class 105C | Class 105C | Class 105C | Class 105C | Class 105C | Class 105C | Class 130C | Class 105C | Class 130C | Class 155C | Class 180C | Class 220C |
| Plain or Black Enamel | Formvar | Acrylex | Formetex | Bondex | Nylon | Nyform | Soderex | Gripex | Soderon | Soderbond Soderbond N | Epoxy | Poly-Thermalex Nytherm Thermalex F | Silicone | Allex |

## FORMVAR

**Service record unequaled in wire industry assures years of trouble free service.** Size range—round wire 4 through 52 single, heavy, triple, quadruple. Squares and rectangles up to 100,000 square mils.

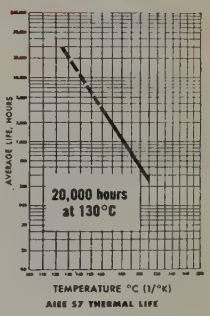
Applications: Class A motor windings, round wire coils of all types, hermetic applications when hermetic grade specified, shaped wire coils, oil filled transformers.




## SODERON®

**Combines the features of Soderex with exceptional windability.** Size range—4 through 44 single, heavy, triple, quadruple.

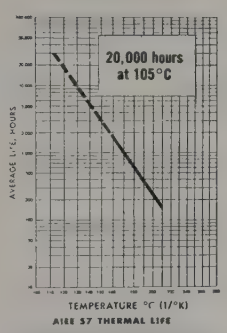
Applications: Light duty stator and armature windings, transformers, relays, coils. Particularly recommended for 27 and heavier wire where solderability is a requirement.




## NYFORM

**The complete dependability of Formvar with a plus factor in windability.** Size range—round 4 through 44 single, heavy, triple, quadruple.

Applications: High speed motor windings, hand tool motor armatures, Class A coils and transformers of all types. Particular adaptability where overload resistance is required.

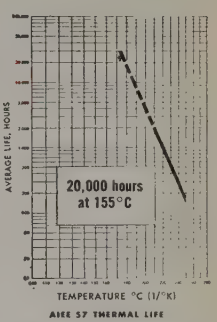



## POLY-THERMALEX/PTX

**A Class F magnet wire at Class A prices offering machine windability.** Size range—4 through 40 single, heavy, triple, quadruple. Squares and rectangles up to 100,000 square mils.

Applications: General purposes—motors Class A through F, dry type transformers, relay coils. An excellent replacement for glass fabric wire.

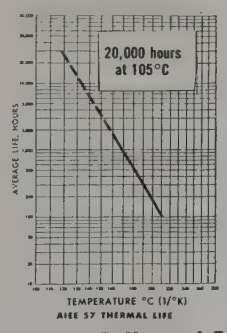
*Licensed Under Patents Pending*




## SODEREX®

**Solderable without film removal.** Size range—10 through 52 single, heavy, triple, quadruple.

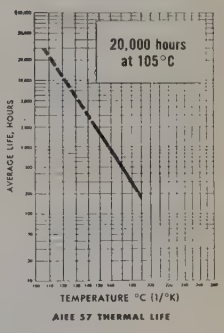
Applications: Electronic coils, light duty motor and armature windings, transformer coils, relays. The correct choice for a product requiring solderability without stripping in the finer wire sizes. Particularly recommended for solderable insulation on sizes 28 and finer.




## PLAIN ENAMEL

**Premium wire at a reduced cost for coil work.** Size range—10 through 52 single and heavy.

Applications: Relays, paper section coils, power transformers, low voltage automotive coils. Will not exhibit resistance to physical abuse associated with synthetic films.




*E. I. duPont De Nemours & Co.—Type ML Resin.

*For your magnet wire planning contact Essex for instant assistance*

**MAGNET WIRE DIVISION**

**ESSEX WIRE CORPORATION**
**Fort Wayne, Indiana**
*National Network of Warehouses and Sales Offices*

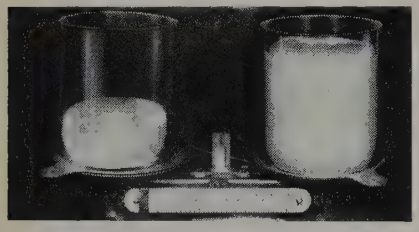
**Print Ins. 23 on Reader Service Card**

proved thermal properties, and high resistance to solvents and chemicals are reported. The numerous reactive epoxy groups in KER resins are also said to provide the resin formulator with a greater opportunity for modifying resin properties. Major uses are for coatings, tooling, encapsulation and potting, laminates, adhesives, and vinyl stabilizers. Sample quantities available. Specialty Chemical Sales Section, Tar Products Div., Koppers Co. Inc., Koppers Building, Pittsburgh 19, Pa.

*Print No. Ins. 118 on Reader Service Card*

### *Powdered Epoxy Foams*

New series of powdered epoxy foams is designated "Eccofoam" EFF. Each product is supplied as a one-component, finely divided powder. To use, a quantity of powder is introduced to a mold or cavity and moderately heated. The result is claimed to be a rigid, uniform foam structure which completely fills the volume.

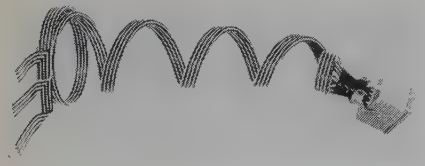


Simplicity in production is cited as the chief advantage of the system. Foam quality from an electrical and physical standpoint is said to be exceptional. The foams can be used from —65°F to +300°F. Other properties inherent in epoxies, i.e. good adhesion, moisture resistance, etc., are reported to be preserved. Materials are in the $3/lb price range. Bulletin 6-2-7 available. Emerson & Cuming Inc., Canton, Mass.

*Print No. Ins. 119 on Reader Service Card*

### *Extensible, Multi-Conductor Cable*

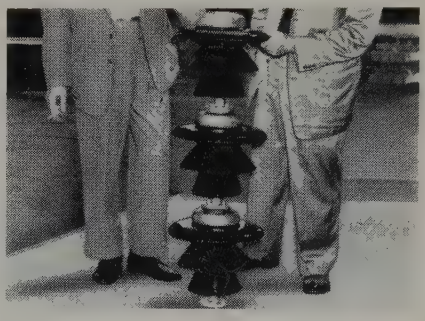
New design in a line of extensible cables, a conical helix, is said to be particularly suited for extension and retraction in a vertical plane. Cable retracts into a flat disc. It is custom built for each application in all gauges from #10 AWG to #30 AWG. Large numbers of conductors reportedly can be used in any type of insulation, provided it has a vinyl jacket. Spectra-Strip Wire & Cable Corp., P. O. Box 415, Garden Grove, Calif.



*Print No. Ins. 120 on Reader Service Card*

### *Lighter, Stronger Switch and Bus Stacking Insulators*

Cost, installation, and maintenance savings are said to be provided by new switch and bus stacking insulators. Two units serve for all applications ranging from 115 through 161 kv at 450 through 750 kv BIL. For any given BIL rating, the insulator

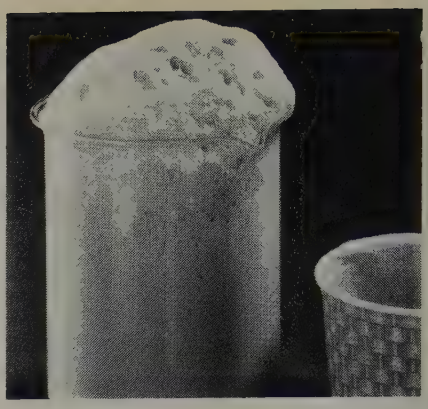


units in a stack are identical. The high strength porcelain, cap and pin type insulators are built on a 3″ bolt circle. Mechanical strength reportedly compares to NEMA standard 5″ bolt circle units of comparable ratings but cost is up to 40% less and weight is as much as 30% less. I-T-E Circuit Breaker Co., Victor Insulators Div., Victor, N. Y.

*Print No. Ins. 121 on Reader Service Card*

### *RTV Silicone Rubber Foam with Good Electrical Properties*

A low density, silicone rubber foam that vulcanizes at room temperature is identified as "Silastic" RTV S-5370. It is supplied as a low viscosity fluid to which a catalyst is added to produce the foam. The catalized fluid pours easily before the foaming is complete (4-5 minutes at room temperature). These silicone rubber foams are said to be serviceable from —70 to 500°F, and to have good electrical properties. Typical values reported include electric strength of 50 vpm (ASTM D 149), dielectric constant at $10^5$ cps of 1.17 (ASTM D 150), dissipation factor at $10^5$ cps of 0.001 (ASTM D 150), volume resistivity of $3.8 \times 10^{12}$ ohm-



centimeters (ASTM D 257), and surface resistivity of $1.0 \times 10^{12}$ ohms (ASTM D 257). Bulletin 9-417 available. Dow Corning Corp., Midland, Mich.

*Print No. Ins. 122 on Reader Service Card*

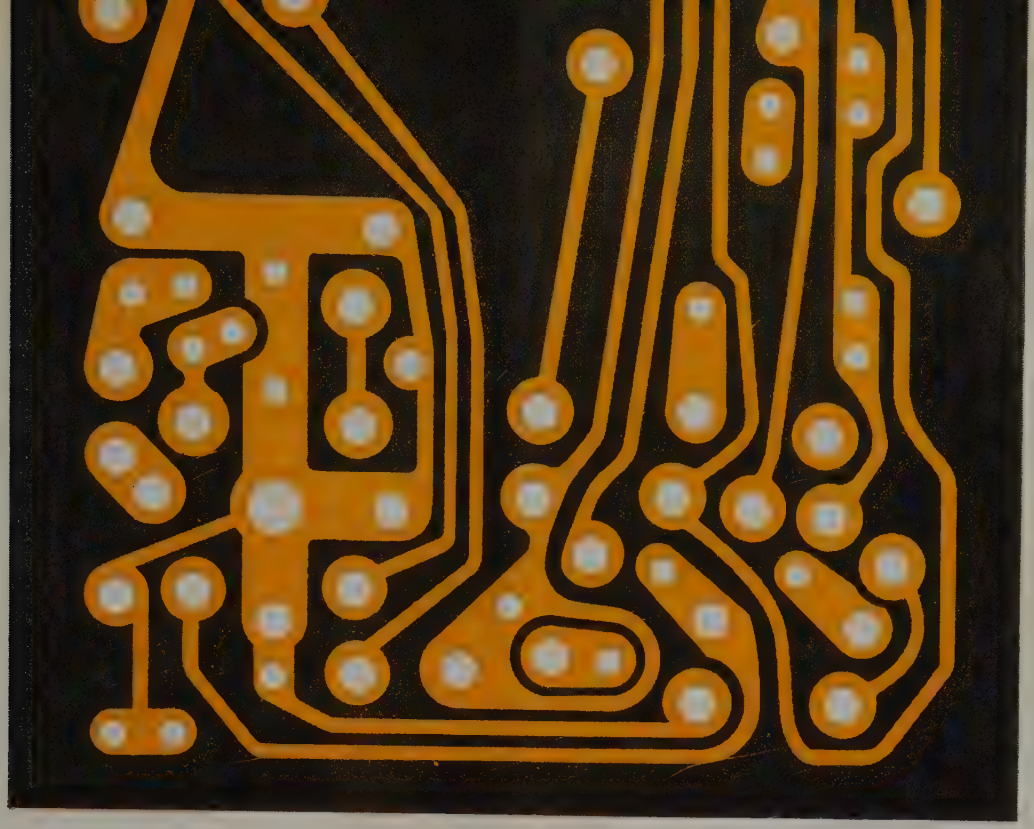
### *Quick-Curing Adhesive For Bonding Polyolefins*

A new thermo-setting adhesive, called "Raiseal" 5002, has been developed for bonding polyolefins. Among applications cited are: potting and encapsulation of polyethylene or irradiated polyolefin wire, and printed circuit boards requiring plastic-laminated copper. Rapid curing at relatively low temperatures is also featured. The new adhesive is claimed to be effective on polyethylene surfaces without pre-treatment by flaming, corona, or chemical dips. Radiation Applications Inc., 36-40 37th St., Long Island City 1, N.Y.

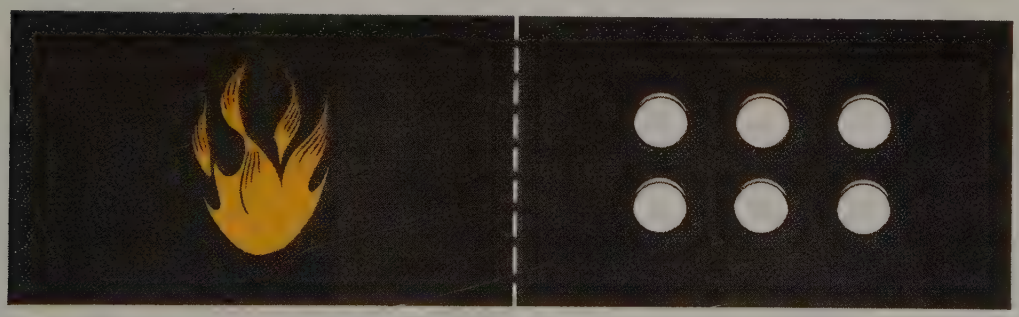
*Print No. Ins. 123 on Reader Service Card*

### *Epoxy Packages for Miniature Electronic Circuit Modules*

Standard modular packages for miniature electronic circuits molded from epoxy compounds, called "Circupaks," are said to provide quick and easy encapsulation of circuit components. Each consists of two pieces: a header with gold-flashed pins staked in place; and a snap-on case with a hole in the top for filling. In curing, potting compounds fuse with the case and header to form a solid, environmentally sealed unit. Various cube and cylindrical shapes are available. Features cited include: standardization of components, elimination of molds and messy methods of potting small circuits, improved appearance, and full circuit protection. Descriptive literature, prices, and sample kit ($5) are available. U. S. Dielec-



# Now...phenolic laminates with both flame retardance and cold punchability



**NEW RESINOX 495 VARNISH** makes it possible for the first time to produce phenolic laminates with both flame retardance and excellent cold punching characteristics. Paper-based laminates impregnated with Resinox 495 meet the electrical, physical, and mechanical requirements of NEMA standards for XXP and XXXPC copper-clad laminates—yet they cost less than other laminates with equivalent properties.

Resinox 495 Laminates are especially recommended for printed circuits used for commercial radio and TV applications, and as copper-clad laminates for electronic computers and military applications, or for any other application where flame retardant laminates are desirable or mandatory. Use coupon below for additional data and list of leading laminators now supplying 495 laminates.

**MONSANTO** INITIATOR IN **PLASTICS**

Monsanto®

MONSANTO CHEMICAL COMPANY, Plastics Division
Room 836, Springfield 2, Mass.

Please send me technical data bulletin on Resinox 495, also list of laminators supplying 495 laminates.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

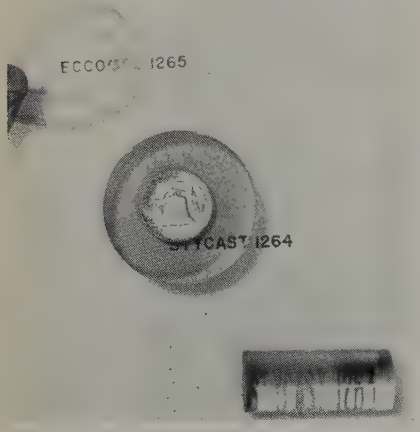
***Print Ins. 24 on Reader Service Card***

tric Inc., 140 Adams St., Leominster, Mass.

*Print No. Ins. 124 on Reader Service Card*

### Transparent Epoxy Resins

A new family of transparent epoxy resins known as "Stycast" 1263 and 1264, and "Eccogel" 1265 are all clear, almost water-white resins whose uses differ as do their physical and electrical properties. Dielectric constant at 108 cps of 3.0 and dissipation




factor at 108 cps of 0.02 is reported for all three resins. Hard, rigid 1263 is designed for embedding transformers and coils; tough, flexible 1264 is for laminating; and 1265, a firm gel, is recommended for repairable embedments of all kinds. Adhesion of all three is said to be exceptional. Bulletins available. Emerson & Cuming Inc., Canton, Mass.

*Print No. Ins. 125 on Reader Service Card*

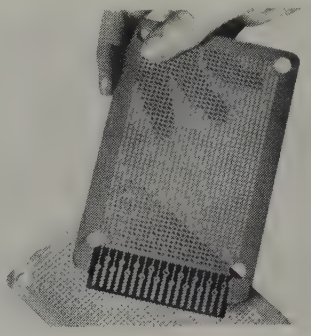
### Insulating Varnishes Based on Diallyl Phthalate Resin

Insulating varnishes based on diallyl phthalate and diallyl isophthalate resins, 23-X4 and 23-X5, are transparent protective coatings offered for coating, sealing, or dip encapsulating of such parts as capacitors, resistors, transformers, motor windings, transistors, diodes, and form-wound coils. These coatings are said to give unusual resistance to moisture, chemicals, corrosive gases, fungus, weathering, and aging over a wide temperature range. The 23-X4 formulation is designed to function at continuous 150°C, while 23-X5 is for use at 180°C. Exceptional insulating, electrical, and dimensional stability properties are reported. Ram Chemicals Inc., 210 E. Alondra Blvd., Gardena, Calif.

*Print No. Ins. 126 on Reader Service Card*

### New Configurations in Glass-Ceramic Printed Circuit Grid Boards

Two new configurations in "Fotoceram" printed circuit grid boards have been developed. One has new corner mounting holes; the other has



the mounting holes plus a plug section useful for computer design work. The grid boards consist of copper-clad glass-ceramic with a grid of .052″ through-plated holes set .1″ on center. A designer lays out his circuit pattern on the grid with etching resist, then etches away the copper lying beyond the pattern. After this 15-minute etching process, the board is ready for components. The new boards, equipped with silicone rubber mounting grommets, are available in 4″ x 6″ and 6″ x 8″ sizes. Corning Electronic Components, Corning Glass Works, Bradford, Pa.

*Print No. Ins. 127 on Reader Service Card*

### Improved Paper Cable Filler

What is said to be a superior kraft filler is now being used in a wide variety of cable constructions. The new filler is a waterproofed, crimped kraft which is claimed to be highly resistant to "wicking" or moisture absorption. Less tendency to stick to surrounding cable components, thus making stripping easier, is also claimed. The kraft fillers are said to be acceptable under the following industry specifications or standards: Underwriters' Laboratories for service cables; all cables to IPCEA standards, except portable cords and cables; and IMSA specifications (except designations 17—1, 2, 4, and 5). Simplex Wire & Cable Co., Cambridge, Mass.

*Print No. Ins. 128 on Reader Service Card*

### Two Glass/Polyester Molding Compounds for Electrical Parts

Two new compounds of fiber glass reinforced polyester have been developed for molding electrical parts. Parts produced with grade 1706 compound are reported to have a dielectric strength of more than 400 vpm and an IZOD impact strength of 6 ft lbs/in. Excellent thermal stability, compatibility with other insulating materials, and high corona starting voltages are other properties reported. Coil shells and forms are a typical application. Parts produced with grade 1504 compound are said to have UL-recognized flame retardance, an IZOD impact strength of 3 ft lbs/in, and excellent moldability in deep draw parts. Circuit breaker housings and standoff insulators are typical applications. The Glastic Corp., Molding Materials Div., 4321 Glenridge Road, Cleveland 21, Ohio.

*Print No. Ins. 129 on Reader Service Card*

### Epoxy-Silicone Rubber Potting Compound

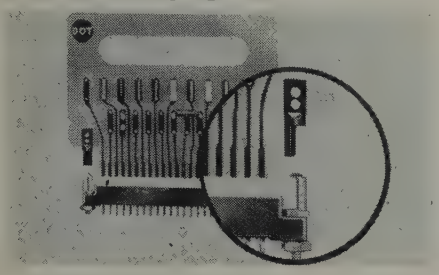
Epoxy resin has now been compounded with silicone rubber to produce a substance claimed to have many of the unique features of each. New "Eccosil" 4712 is said to possess the adhesive properties of epoxies as well as the resiliency of silicone rubber. It is described as a permanently plasticized, high temperature epoxy. Supplied as a two-part, free-flowing material (viscosity — 60,000 centipoises), it reportedly can be used at

temperatures up to 450°F (232°C) continuously, and can tolerate even higher temperatures for intermittent periods. It is recommended for potting cable connectors and for a wide variety of electrical and electronic applications requiring a tough, permanently flexible adhesive, with good resistance to moisture and solvents, as well as good electrical characteristics. Price of a 2 lb kit is $10. Bulletin 13-2-2 available. Emerson & Cuming Inc., Canton, Mass.

*Print No. Ins. 130 on Reader Service Card*

### Polarizer for Printed Circuit Cards

Positive protection against incorrect insertion of circuit cards is said to be provided by the "Dot Polarite" plug-and-jack assembly. The device consists of a plug, assembled to the



circuit board, and a jack, assembled to the edge connector. Discrete combinations are achieved through a patented method of aligning the hexagonal head of the plug so that it will be accepted only by a jack with the corresponding mating angle. Twelve discrete combinations are afforded by each jack and plug combination so that a pair affords 144 discrete combinations. Electronics Div., The Ucinite Co., Newtonville, Mass.

*Print No. Ins. 131 on Reader Service Card*

### Color Codes for Insulation Papers

A color coding system is used for identification of caliper on kraft and glassine electrical insulating papers. Distinct colors for different calipers of paper help avoid use of the wrong grade in assembling critical-tolerance coils and transformers. Color appears on the edge of the paper. The new color coding appears on all grades of both "Insulglass" (formerly called Gotham Electric) and #8 "Coiltronic" (formerly called #8 Coil Kraft) brand insulating papers. Color charts available. Dept. P1-382, Paper Products Div., Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

*Print No. Ins. 132 on Reader Service Card*

### Ceramic Microwave Windows

Ceramic microwave windows with metal window envelopes of various sizes reportedly utilize metalizing techniques which eliminate the problem of braze joint overlap on the plane of the window. Extreme purity is said to be maintained. The windows are produced in sizes from 3/16″ to 3″ diameter, down to .010″ thickness, and are available in rectangular and circular shapes. Ceramics International Corp., 39 Siding Place, Mahwah, N.J.

*Print No. Ins. 133 on Reader Service Card*

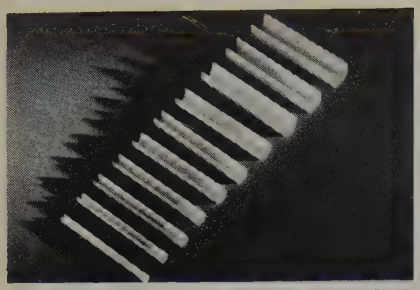
### Neoprene Molding Material Meets Mil-R-6855 Requirements

New polychloroprene (neoprene) injection material is a two-part compound said to meet the requirements of Mil-R-6855, grade II, Class 60 and to be injected at a very low pressure (400-600 psi). It cures in 20 minutes at 180°F. This material reportedly has been successfully used for molding connector backshells and cable breakouts over such low melting, primary insulating materials as polyethylene and PVC. Meg Products, Div. of Mandrel Industries Inc., Box 3115, 1238 Weller St., Seattle 14, Wash.

*Print No. Ins. 134 on Reader Service Card*

### High-Temperature Channel Slot Wedges

Channel slot wedges for electric motors, generators, and other rotating equipment, called "Silcobest," are now available in 66 standard sizes for the following temperature ratings: class "H"—silicone-glass, class "F"—epoxy-glass, and class "B"—polyester-



glass. Each type is color identified. Wedges pretested at specified voltages can be ordered. These wedges are made of two or more layers of woven glass cloth. Price reductions are reflected in a new price list. Silicone Insulation Inc., 1383 Seabury Ave., Bronx 61, N.Y.

*Print No. Ins. 135 on Reader Service Card*

### Flame-Proof Epoxy Has Advanced Properties

An advanced version of a flame-proof, semi-flexible epoxy resin system is called "Scotchcast" brand resin No. 247. The resin is used both as an impregnant and encapsulant for components designed to meet military and Underwriters' Laboratories fire resistant specifications. No. 247 is said to be the first truly "flame-out" epoxy resin. Transformers, resistors and capacitors in nearly all configurations impregnated or encapsulated in this resin reportedly can be expected to meet and exceed the self-extinguishing requirements of LP-406b. Mil-I-16923C, and ASTM D-635 test specifications. Flame resistance and flexibility are built into the epoxy molecule without the use of modifying agents. These qualities are stated to remain permanently with the system through all conditions of use, even after prolonged high temperature aging. Improvements are said to include: 1) Surface arc resistance of the resin has been increased from 3 seconds to 68 seconds. 2) Lower viscosity. 3) Improved storage and handling qualities. 4) Improved mechanical and thermal shock properties. 5) Improved electrical properties at elevated temperatures. Electric strength of 500 vpm and ability to withstand continuous operating temperatures between class B (130°C) and class F (155°C) are reported. Dept. W1-424, Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.

*Print No. Ins. 136 on Reader Service Card*

### Fluorosilicone Fluids With High Dielectric Constant

New FS 1265 fluorosilicone fluid is said to be characterized by a high order of lubricity, inertness, a temperature service range from —40 to +400°F (—40 to +204°C), solvent resistance, incompatibility with most petroleum oils, and high dielectric constant. Typical electrical properties reported are: dielectric constant (100 cycles at room temperature), from 6.9 to 7.3; dissipation factor (100 cycles at room temperature), from 0.06 to 0.001; volume resistivity (ohm-cm), 3.9 x $10^9$ to 4.6 x $10^{13}$; arc resistance, 230 to 250 seconds; and electric strength (50 mil gap), 250 vpm. Fluid also reportedly offers advantages as a plasticizer for rubbers and plastics. Dow Corning Corp., Midland, Mich.

*Print No. Ins. 137 on Reader Service Card*

### Cross-Linked Polyethylene Casting Resin For RF and Microwave Uses

New casting resin designated "Stycast" TPM-6 is stated to be easy to use as an encapsulant and sealant in a variety of radio frequency and microwave applications. TPM-6 is a cross-linked polyethylene type formu-


lation said to be moderate in cost, readily machined, and possessed of excellent electrical and physical properties. It reportedly can be used as a direct substitute for polyethylene in cables, connectors, insulators, and transmission lines, will not cold flow, has a temperature capability surpassing that of polyethylene by approximately 200°F, and has better thermal dimensional stability than polytetrafluoroethylene. Low electrical loss from d-c to microwave frequencies, and a dielectric constant of 2.4 and a dissipation factor below 0.0007 throughout that range are claimed. No catalyst is required. Two-lb sample kit, catalyst included, is available for $6. Bulletin No. 7-2-2D and price list also available. Emerson & Cuming Inc., Canton, Mass.

*Print No. Ins. 138 on Reader Service Card*

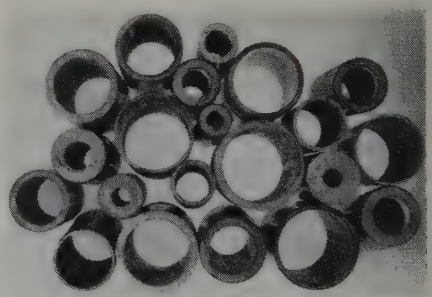
### Flame Retardant Epoxy for Potting, Casting, Coating

New low viscosity, non-crystallizing, 100% epoxy resin recommended for potting, casting, coating, dipping, or sealing is said to have top flame retarding properties. Called "Isochemrez" FR, it may also be used to make self-extinguishing printed circuit boards. Electrical properties reported include: dielectric constant (60 cps), 3.89; dissipation factor (60 cps), .008; dielectric strength, 510 vpm; and volume resistivity, 3.5 x $10^{15}$. Sample kits available for $8. Isochem Resins Co., 221 Oak St., Providence 9, R.I.

*Print No. Ins. 139 on Reader Service Card*

### Laminated, Thermosetting Tube and Rod for Electrical/Electronic Uses

New laminated thermosetting tubular and rod materials for electrical, electronic, and other applications are

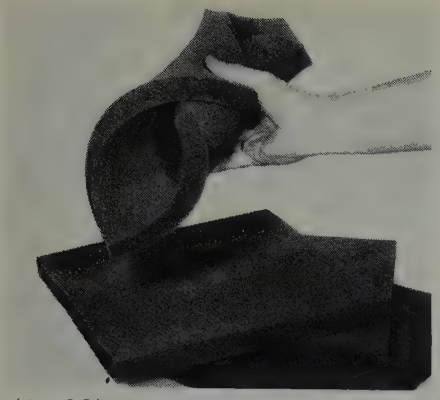


available in continuous lengths up to 12 ft. New EMT-27 material is said to be clearly superior to NEMA G-3, with respect to mechanical properties as well as electrical properties. United States Fiberglass Co., 4001 N. W. 24th St., Miami 42, Fla.

*Print No. Ins. 140 on Reader Service Card*

### Silicone Rubber Foam for Microwave Applications

New silicone rubber foam of very low weight and extreme temperature stability is also said to be flexible, compressible with complete return memory, and quite rugged. Low dielectric constant and exceptionally low dissipation factor are reported to make it an entirely new dielectric material for microwave lens, absorbers, and the like. Continuous temperature limit is reported as 550°F

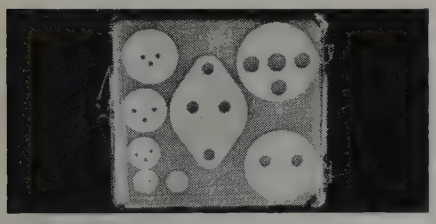


(288°C). Standard 1′ x 2′ x 1″ sheet is priced as low as $15.50 per sq ft. Special sizes and shapes are available. Emerson & Cuming Inc., Canton, Mass.

*Print No. Ins. 141 on Reader Service Card*

### *Kits for Beryllium Oxide Dielectric Heat Sink Evaluation*

Engineering evaluation kits contain technical data and samples of Berlox beryllium oxide dielectric transistor heat sinks. The standard heat sinks

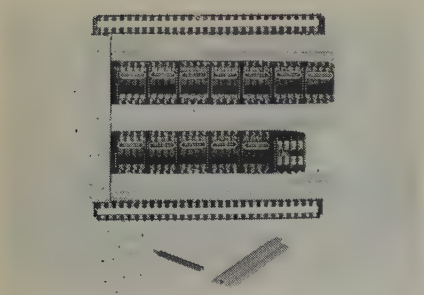


(to fit popular TO semiconductor sizes) are packed in cushioning material in a convenient plastic case. Kits are priced at $18. The kits will allow evaluation of beryllia heat sinks in specific applications, comparisons with conventional dielectric materials, investigation of mounting methods, and similar work. National Beryllia Corp., First & Haskell Ave., Haskell, N.J.

*Print No. Ins. 142 on Reader Service Card*

### *Control Panel Wireway System for 300 V Relay*

A simplified control panel wireway system, made especially for a 300 v relay, takes advantage of the channels that are formed between the horizontal rows of compact relays when mounted on a control panel. The space provides room and protection for wires and permits easier wire accessibility to relay terminals. Other advantages cited are elimination of lacing or threading of wires, greater wiring compactness, and reduced wiring time. Specially designed posts

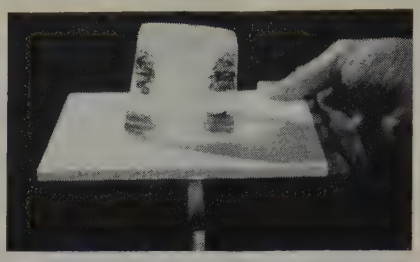


fasten to the control panel at intervals in the vertical center of each channel. The head of each post has slots or grooves to receive the new snap-on cover which is said to be made of a flame resistant, tough, durable, plastic material that has excellent insulating qualities, is easily cut, and is dimensionally stable. ECP Corp., 4726 Superior Ave., Cleveland 3, Ohio.

***Print No. Ins. 143 on Reader Service Card***

### *Foam for 2000°F Use*

New foam product, "Eccofoam" SI, is said to be capable of continuous 2000°F service. It is available in sheet form 6″ x 6″ x ⅛″ (and multiples). Material is claimed to consist of 95% silica with cells of less than 100 microns in diameter. It reportedly can be glazed to result in a completely water impervious, hermetically sealed foam. Dielectric constant of 1.8 and loss tangent of 0.003 are reported. Material is stated to be rugged,



readily machined, and bonded to itself with a ceramic adhesive, or to many other materials. Anticipated uses include RF insulation for microwave transmission lines and as dielectric for vacuum metallized capacitors. Bulletin 6-2-12B available. Emerson & Cuming Inc., Canton, Mass.

***Print No. Ins. 144 on Reader Service Card***

### *Ceramic Filled Epoxy for Potting and Casting*

A new, medium viscosity, low density ceramic microballoon filled epoxy casting and potting resin system reportedly has excellent strength and high structural stability and may be machined and cut to size. High volume of microballoons permits a density of .67 against normal filled epoxy's density of 1.45 or unfilled epoxy at 1.15. Full epoxy properties are claimed. Wide use in electronic, missile, or instrument sealing, potting, or encapsulation fields is expected. Actually a foam-in-place system, suggested applications include: light density protection of units in pots or cans; large bulk, light weight castings; for lowering the density of normal epoxies; and for packaging to resist shock. Sample kits available for $9. Isochem Resins Co., 221 Oak St., Providence 9, R.I.

***Print No. Ins. 145 on Reader Service Card***

### *Flexible, Flame-Out Casting Compound*

New flexible, flame-out casting compound was designed for encapsulating transformers required to meet Mil-T-27A, class S, grade 2 & 5, but is suitable for module, capacitor, coil, resistor, and diode encapsulation as well. The two-component heat cure


# FORMVAR based wire enamels... best for Class B systems, too!

That's right . . . now you can extend your use of FORMVAR based wire enamel to Class B systems. The method is simple. Merely impregnate FORMVAR based wire enamel with one of the newer commercially available impregnating varnishes. The combination offers increased thermal stability of the entire system—and you get all of the proved advantages of FORMVAR. Excellent windability, high overload resistance, and resistance to heat, moisture, cut-through and abrasion.

This technique to upgrade thermal stability has been proved in use. Shawinigan has always been first with new developments, new applications and technical assistance for the wire industry. Twenty years background in producing polyvinyl formal resin—the basic ingredient in *all* FORMVAR based wire enamel—assures you of the best in products, the best in service. For more information on the easiest, most dependable combination of commercial varnish overcoat and FORMVAR based wire enamel, write Shawinigan Resins Corporation, Dept. AQ, Springfield 1, Massachusetts.

SALES OFFICES: ATLANTA, CHICAGO, LOS ANGELES, NEW YORK, SPRINGFIELD, CLEVELAND, SAN FRANCISCO, GREENSBORO, ST. LOUIS.

IN ENGLAND AND EUROPE: SHAWINIGAN LTD., MARLOW HOUSE, LLOYD'S AVENUE, LONDON E.C. 3.

**FORMVAR® polyvinyl formal by SHAWINIGAN RESINS®**

**Print Ins. 28 on Reader Service Card**

system is said to have a low working viscosity and a 3-day pot life at room temperature. Excellent electrical and physical values are reported. It is also said to pass thermal shock washer test and the ASTM D635-56T test on self-extinguishing. Bulletin DPE-14 available. Hysol Corp., Olean, N.Y.
***Print No. Ins. 146 on Reader Service Card***

#### *Low Cost Plasticizer for PVC*

New, general purpose polymeric plasticizer for polyvinyl chloride, trademarked "Santicizer" 411, is an adipic acid-glycol polyester which is said to offer excellent permanence and resistance to migration and extraction as well as cost breakthrough in permanent plasticizing of PVC. Price is 34 cents/lb in bulk quantities with freight allowed. Santicizer 411 is reported to be unique in its excellent resistance to extraction either by mineral oils or soapy water. Bulletin No. PL-411-D available. Organic Chemicals Div., Monsanto Chemical Co., St. Louis 66, Mo.
***Print No. Ins. 147 on Reader Service Card***

#### *Copper-Clad, Epoxy/Glass Laminate With High Temperature Stability*

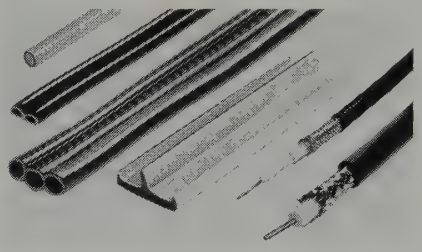
A new copper-clad epoxy glass laminate is said to exhibit superior stability at high solder temperatures. The new NEMA G-10 grade, designated "Textolite" 11578, has completed field evaluation with no evidence of adhesive failure between the glass fiber and the epoxy resin. Improved circuit board stability, or lack of distortion, at soldering temperatures (500°F) and under heavy loading of components is also claimed. It is also reported that 11578 has outstanding machineability and meets the requirements of Mil-P-18177C, type GEE, and Mil-P-13949B, type GE. Laminated Products Dept., General Electric Co., Coshocton, Ohio.
***Print No. Ins. 148 on Reader Service Card***

#### *'Teflon' Coated Glass Fabric*

A new type of Teflon fluorocarbon resin coated glass fabric said to have superior electrical properties is being offered for testing. Other property advantages expected are lower permeability, lower heat sealing and laminating temperatures, and lower moisture absorption. The FEP coated glass fabrics are now available in limited quantities in eight constructions, and are expected to provide applications not presently open to the TFE type of coated fabrics. It is believed that the new material will meet with considerable interest in the aircraft, missile, printed circuit, and cable industries. Bulletin available. Room WT-902, Fabrics and Finishes Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.
***Print No. Ins. 149 on Reader Service Card***

#### *Custom Extruded Thermoplastics, Wires, and Coaxial Cables*

Plastic tubing, rods, shapes, insulated cables and wires, molding and specialties to customer specifications are included in a complete line of plastic processing services. Flexible or rigid vinyls, polyethylene,



polypropylene, acetate, butyrate, nylon, and other thermoplastics are available. All types of wire and coaxial cables are also available. Martin Plastics Inc., 351 Oliver St., Newark, N.J.
***Print No. Ins. 150 on Reader Service Card***

#### *Phenolic Impregnated Glass Cloth for High Heat, Arc Resistant Use*

A new glass cloth impregnated with high temperature resistant phenolic resin is identified as grade 5H966. The material is said to be especially applicable to production of laminates or molded parts for high temperature service, and to be qualified for electrical applications by outstanding electrical properties, particularly high arc resistance. The material can be molded in sections up to several inches in thickness. Molded parts which can be made of 5H966 include convolutely wound tubes, molded channels, rods, angles, and other simple geometric shapes. Westinghouse Electric Corp., Micarta Div., Hampton, S.C.
***Print No. Ins. 151 on Reader Service Card***

#### *Alumina Ceramic Substrates And Terminal Boards*

Substrates and miniature wafers of 96% aluminum oxide are smoothly polished or thin-film glazed for maximum surface smoothness. The substrates are extremely flat and are said to be notched, drilled, or slotted to less than $\pm 0.001''$ tolerance. The thin, uniform glaze reportedly provides excellent electrical insulation and the smooth surface is suited for IR mirrors as well as for modular circuits. Developed for precision, thin-film metalizing and various fired-on metal applications, the substrates are stated to be capable of very high to very low temperature operation. The ceramic base is thermally stable, hard, inert, and non-corrosive. Brochure available. Electro-Ceramics Inc., 2645 S. 2nd West, Salt Lake City 15, Utah.
***Print No. Ins. 152 on Reader Service Card***

#### *Heavier Polyester Film Insulation For Motors, Connectors, Circuit Boards, Etc.*

A new 1400 gauge (14 mil) "Mylar" polyester film, a heavier, more rigid material for electrical insulation, is designed for use as wedge insulation in hermetic motors, slot liners in integral motors of from 5 to 50-hp ratings, end laminations on armature and wound rotor stacks, insulators in wall plugs and electrical connectors, circuit boards, and other electrical applications. Typical property values reported are: dielectric strength, 25 kv a-c; dielectric constant at 1,000 cps, 3.3; dissipation factor at 1,000 cps, 0.0052; tensile strength, 20,000 psi; elongation, 200-250%; shrinkage at 150°C, two to 3.5%; thermal life in oil at 150°C, more than 2,000 hrs; melting point, 245-260°C; moisture absorption, immersed for 24 hrs, 0.05%. Film Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.
***Print No. Ins. 153 on Reader Service Card***

### Clear Epoxy Casting System

A new, clear colorless epoxy casting system is designed to cure at 175°F to 225°F. Thermoset resin No. 609 reportedly gives castings of perfect clarity yet has the excellent physical, electrical, and adhesive properties of an epoxy. Long pot life and low viscosity are other features claimed. Thermoset Plastics, 4015 Millersville Road, Indianapolis, Ind.

***Print No. Ins. 154 on Reader Service Card***

### Easy-Processing Silicone Rubber With Good Electrical Properties

A new, easy-processing silicone rubber is designed to meet the 40 durometer requirements of various military specifications. Good electrical properties are reported. Soft and nontacky, Silastic 241U reportedly has good green strength, bands readily on mill rolls without crumbling, and requires very little mill softening. Finished parts can be manufactured by molding, extruding, or calendering. Shrinkage during manufacture is low. Suitable for use from —80 to 500°F, it is said to retain physical strength and flexibility after long exposure to temperatures in this range. Bulletin 9-501 available. Dow Corning Corp., Midland, Mich.

***Print No. Ins. 155 on Reader Service Card***

### High Voltage Cable Insulated with Corona Resistant 'Teflon'

New line of standard cable is designed for high voltage applications where extremes of temperature, corrosive environment, abrasion, or mechanical strain are encountered. The insulation for the cable is designated as CR (corona resistant) Teflon and contains an agent that reacts under corona bombardment to form a liquid. The liquid covers the walls of the corona cavity with a protective film. This film reportedly absorbs the impact of corona ions, preventing them from penetrating through the solid dielectric. The standard line of CR Teflon cables are rated up to 15,000 v a-c and 50,000 v d-c. Higher voltage ratings are available as special designs. W. L. Gore & Associates Inc., 487 Paper Mill Rd., Newark, Del.

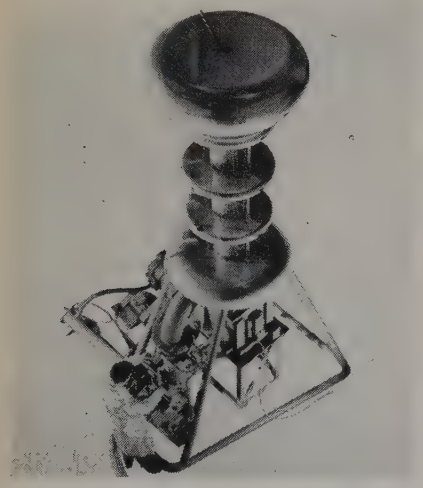
***Print No. Ins. 156 on Reader Service Card***

# *New Instruments and Equipment*

*For further information on these products print the item number on the Reader Service Inquiry Card on the back cover. Fill out and mail the card—no postage is required.* Insulation *will immediately forward your inquiry to the manufacturers concerned so that they can send you more information promptly.*

### Particle Accelerator

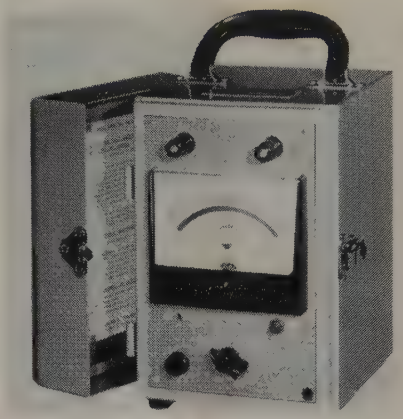
New particle accelerator designed for use in basic research and other applications reportedly offers highly stable continuous d-c outputs from zero to 600 kv with infinite adjustment, and can produce a wide range of particles and radiations (electrons, protons, neutrons, deuterons, x-rays, etc.). Components are not enclosed in



a pressure vessel and are therefore readily accessible. Both vertical and horizontal models are available with or without switching for acceleration of ions or electrons. In use as either an ion or electron accelerator, the unit is said to be capable of supplying extremely strong radiation doses. SAMES, 30 Broad St., New York 4.
**Print No. Ins. 201 on Reader Service Card**

### Portable Ohmmeters Offer Accuracy to 0.5%

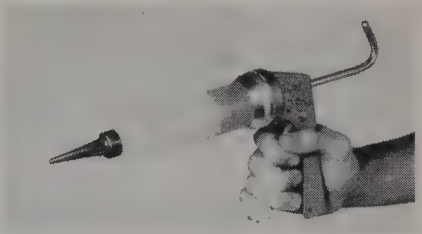
Two new portable ohmmeters are said to offer accuracy of 0.5%. They have a built-in resistance standard which permits instant calibration to compensate for changes in resistance of test leads and internal resistance of the self-contained battery. Model



244-A ohmmeter has four ranges, allowing direct reading measurements from 0.05 ohm to 50,000 ohms, with a center-scale value of 1.2 ohms on the low range; model 246-A provides measurement from 0.1 ohm to 100,000 ohms. Both models are equipped with a new indicating meter having a mirrored scale 4½″ long. Bulletin available. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.
**Print No. Ins. 202 on Reader Service Card**

### Hand-Operated Gun Dispenses Sealing and Caulking Compounds

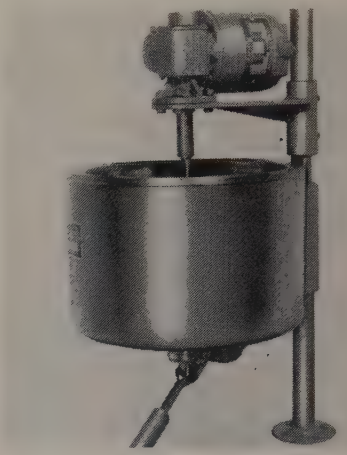
All-metal, manually-operated sealant gun is designed for use with standard 2½ oz and 6 oz polyethylene cartridges in dispensing any of the new one and two-part compounds, adhesives, epoxies, polysulphides, and silicones. The SP 1832 hand gun is



said to be ideal for general use or in the field where air pressure is not available. Clean-up is eliminated, as the polyethylene cartridges are disposable, and at no time does any metal part contact the compound being dispensed. Pyles Industries Inc., 20855 Telegraph Road, Detroit 41, Mich.
**Print No. Ins. 203 on Reader Service Card**

### Electrically Heated Dispenser

A specially designed, electrically heated compound dispenser operates with heat uniformly applied to the entire bottom and 75% of the sidewall area by a multiple circuit heating element, assuring uniform temperature throughout the tank's contents. Equipped with a motor agita-



tor, the "B.O.V." dispenser is available in 4-qt through 25-gal sizes and contains a ⅜″ bottom-operated valve. Standard temperature ranges are 150 or 250 to 550°F. Bulletin D3 available. Sta-Warm Electric Co., Ravenna, Ohio
**Print No. Ins. 204 on Reader Service Card**

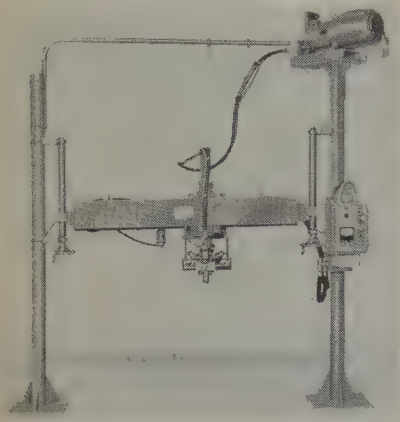
### Portable Lift for Loading Motors and Transformers

New No. 336 "Port-A-Gate" lift, was designed especially for loading and unloading heavy equipment such as motors and transformers from standard trucks, vans, and station wagons. It may also be used as a work table. Repair work may be done while the motor is still on the pallet. It may be completely disassembled to fit in the trunk of an automobile. This is said to make it possible for one man to load or unload heavy motors or transformers at any location. Other features cited are: interchangeable fork or pallet lift; glides for going up and down stairs; and detachable load wheels which prevent load from tipping backwards. Cost is $188.80. Insulation and Wires Inc., 1510 Wall St., Fort Wayne 6, Ind.
**Print No. Ins. 205 on Reader Service Card**

### Traverse Mechanism for Polyurethane Foam Production

New air-operated traverse mecha-

nisms adjustable in height, stroke, and traversal rate are now available for polyurethane foam producing installations making rigid and flexible slab stock or pouring over large areas. The rotary type, pneumatic prime mover is stated to assure smooth re-

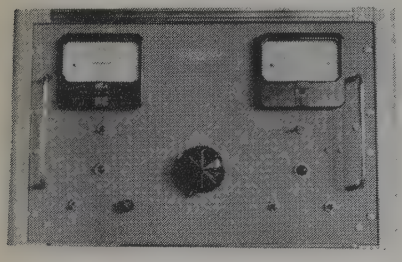


ciprocation through the natural cushioning of an air system. Roller bearings support the carriage which reportedly cannot jam at the stroke limits, even if the limit controls are removed. Bulletin T10 available. The Martin Sweets Co. Inc., 3131 West Market St., Louisville 12, Ky.

*Print No. Ins. 206 on Reader Service Card*

### *Improved Hipot Testers*

Hipot tester redesign is said to feature several improvements at no price increase. The 5 microamp overcurrent circuit breaker is now continuously adjustable from near zero to



5000 microamps through the use of a meter relay, used also as a current meter. Other features cited include accurate and direct monitoring of either the a-c (rms) or d-c output voltage and a grounded return for easier testing. New bulletin available. Peschel Electronics Inc., Towners, Patterson, N. Y.

*Print No. Ins. 207 on Reader Service Card*

### *Thermo-Electric Wire Insulation Stripper*

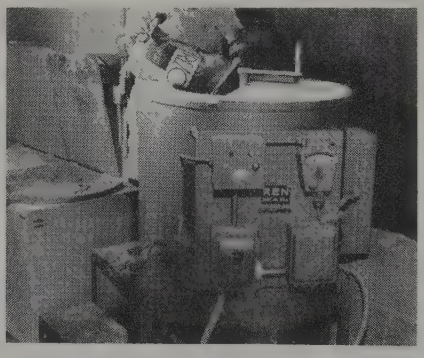
New thermal device for removing the insulation from the ends of wires reportedly leaves no ragged, burned or charred ends. Model TS 400 is designed to be used as a hand stripper for chassis, harness, or cable work, or as a bench model for production work

by placing it in the slide-on clip mounted on top of the power unit. It will handle wire sizes from No. 6 to No. 36 AWG. A switch provides high heat for "Teflon" and low heat for vinyl, nylon, FEP Teflon, PVC, "Kel-F," polyethylene, etc. An adjustable wire stop is provided for stripping length up to ¾". However, longer lengths can also be stripped. Price is $56.50. National Missile & Electronics Inc., 5307 West Century Blvd., Los Angeles 45, Calif.

*Print No. Ins. 208 on Reader Service Card*

### *Kettle Melts Organic and Inorganic Materials at 300 to 600°F*

A closely controlled kettle has been developed to melt organic or inorganic materials at temperatures between 300 and 600°F. The new "KA" kettle incorporates a cylindrical melt-

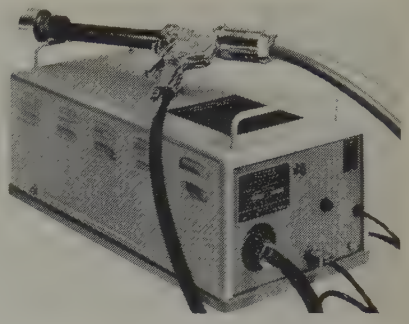


ing tank. Heat is said to be applied uniformly around the sides as well as on the bottom. Adjustable automatic controls reportedly hold the melt material within ±5°F at any molten temperature to 550°F. An agitator is furnished for manual or motor driven mixing. Available in capacities from 90 to 5,800 lbs. Trent Inc., 211 Leverington Ave., Philadelphia 27, Pa.

*Print No. Ins. 209 on Reader Service Card*

### *Hand Gun for Electrostatic Spray Coating with Plastic*

A new electrostatic hand spray gun is said to be capable of coating even intricate shapes with plastic or enamel powders. The portable unit can also be used for other applications such as paper coating. The "Stajet" equipment consists of an electrostatic generator, a spray gun with an anti-sparking head; and a powder reservoir with vibrator. In operation,

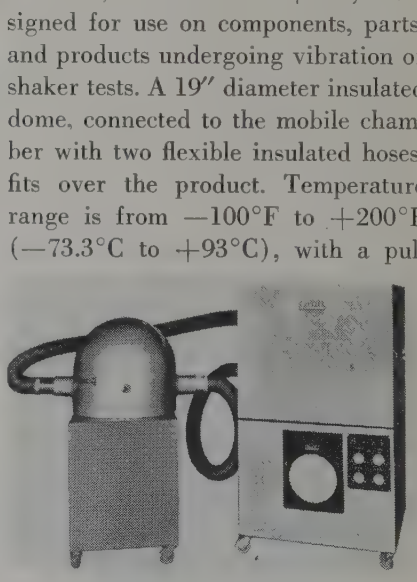


emerging coating particles are electrically charged and then directed to, and evenly deposited on, any object within the influence of the electric wastage, production time savings, and automatic current adjustment as a field. Smooth coatings, no coating function of powder flow are features reported. Other advantages listed are noise-free operation, small power consumption (100 watts), adaptability to factory or field work, and no danger of high voltage shock. Price of the gun is $1700. Powder reservoir is $450. (Both FOB Grenoble, France.) SAMES, 30 Broad St., New York City.

*Print No. Ins. 210 on Reader Service Card*

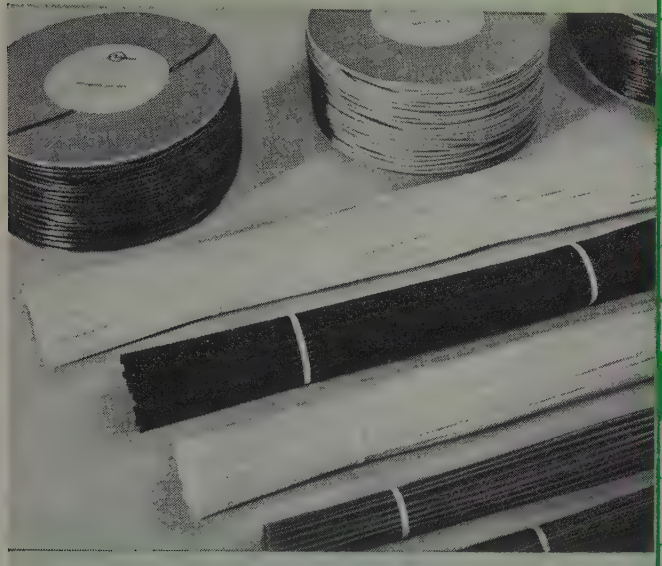
### *Portable Environmental Chamber For Vibration Testing*

A new portable environmental chamber, model W-2-100+200, is designed for use on components, parts, and products undergoing vibration or shaker tests. A 19" diameter insulated dome, connected to the mobile chamber with two flexible insulated hoses, fits over the product. Temperature range is from —100°F to +200°F (—73.3°C to +93°C), with a pull



# NATVAR TUBING AND SLEEVING

For a Wide Range of Military Electronic and Electrical Uses.



| General Purpose Extruded Vinyl Tubing | |
|---|---|
| Natvar 241 | MIL-I-631C, Type F, Form U, Grade A, Class II, Category 1. |
| Natvar 261 | MIL-I-631C, Type F, Form U, Grade A, Class I & II, Category 1. |
| **Low Temperature Extruded Vinyl Tubing** | |
| Natvar 361 | MIL-I-631C, Type F, Form U, Grade B, Class I & II, Category 1. |
| Natvar 362 | MIL-I-7444B, Type I, II & III, Range I, II & III. |
| Natvar 363 | MIL-I-22076. |
| **High Temperature Extruded Vinyl Tubing** | |
| Natvar 461 | MIL-I-631C, Type F, Form U, Grade C, Class I & II, Category 1. U/L Approved for 105°C Continuous Operation. |
| Natvar 400 | U/L Approved for 105°C Continuous Operation. |
| Natvar 500 | Specially Formulated for Use in Transformer Oil. |
| **Natvar Coated Fiberglas Sleevings** | |
| Vinyl | MIL-I-21557 (Grade A Only) and MIL-I-3190B. |
| Isolastane (Polyurethane) | MIL-I-3190B. |
| Silicone Rubber | MIL-I-18057A (Grade A Only). |

Natvar

## Natvar Products

- Varnished cambric—sheet and tape
- Varnished canvas and duck—sheet and tape
- Varnished silk and special rayon—sheet and tape
- Varnished papers—rope and kraft—sheet and tape
- Varnished, silicone varnished and silicone rubber coated Fiberglas*—sheet and tape
- Slot cell combinations, Aboglas®
- Teraglas®
- Isoglas® sheet and tape
- Isolastane® sheet, tape, tubing and sleeving
- Vinyl coated and silicone rubber coated Fiberglas tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape

*TM (Reg. U.S. Pat. Off.) OCF Corp.

*We will be very happy to supply information on any of our products on request.*

NATVAR is synonymous with quality throughout the world. Among the many outstanding insulations now serving the needs of the military and industry are Natvar extruded tubings and coated sleevings.

These are made to perform in a wide range of temperatures from —68°C to 180°C and above, and to meet the electrical and mechanical requirements of applicable military and industry specifications. In addition, most have superior resistance to oil, alkali and flame; excellent flexibility, and exceptional toughness and ability to withstand abrasion.

The specially compounded formulations used in Natvar extruded tubings and coated sleevings are subjected to systematic and rigorous quality control from raw materials to finished product. The name Natvar is your guarantee of quality and uniformity.

Shipments of standard items can be made the same day from distributor's or factory stock. Samples are available on request.

## NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

| Telephone | TWX | Cable Address |
|---|---|---|
| FULTON 8-8800 | RAHWAY, N.J., RAH 1134 | NATVAR: RAHWAY, N.J. |

239 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

**Print Ins. 31 on Reader Service Card**

down from maximum to minimum temperatures in 45 minutes. Internal air circulation is said to assure zero stratification throughout the entire range. Webber Manufacturing Co. Inc., P. O. Box 217, Indianapolis 6. Ind.

***Print No. Ins. 211 on Reader Service Card***

### *New Infrared Lamps For Ovens and Testing*

Seven T-3 quartz infrared lamps have been added to a line of lamps available for infrared applications such as industrial ovens and elevated temperature testing. Three of the new lamps have a higher power rating than current types, one has a lower power rating than present models, and the three remaining new types of lamps have ratings of: 500 watts at 105 v, 1000 watts at 208 v, and 1600 watts at 230 to 250 v. The life of these lamps is said to be in excess of 5000 hrs. The metallic bases are connected to 6″ flexible leads. Westinghouse Lamp Div., MacArthur Ave., Bloomfield, N. J.

***Print No. Ins. 212 on Reader Service Card***

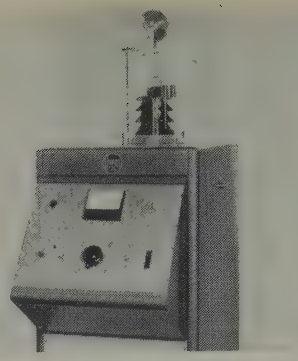
### *Temperature Protectors for Motors*

New temperature sensors that may be installed in the end windings or stator slots of electric motors to provide protection against overheating are labelled CR124H inherent protectors. They reportedly may be applied safely in integral horsepower motors through 200 hp, 600-v maximum. Larger motors may be protected with these devices with special design considerations. General Electric Co., Schenectady 5, N. Y.

***Print No. Ins. 213 on Reader Service Card***

### *Dielectric Strength Tester for Insulating Liquids, Sheets, and Solids*

Model 4712 Hypot materials tester for determining dielectric strength of insulating liquids, solids, and sheets at potentials to 60 kv has an oil sample test-fixture complete with disc, mushroom electrodes, and gap gauges to meet United States, English, and German test specifications. The test cage is safety interlocked and may be provided with rapid change jacks that accept a full line of insulating materials test-fixtures, making possible dielectric strength determinations on

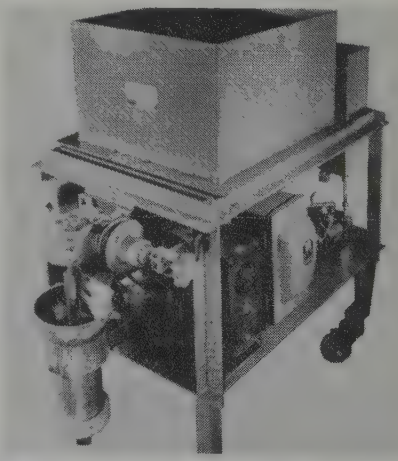


sheets, tapes, thick solids, encapsulating and potting compounds, laminated sheets, oils, and other liquids as well as many additional materials. Applicable requirements of ASTM. MIL, and Federal test specifications are said to be fully met. The d-c test potential is continuously variable from 0 to 60 kv. with maximum output rated at 2 kva. Manual G-65 available. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

***Print No. Ins. 214 on Reader Service Card***

### *Unit Mixes and Meters Filled, Viscous Epoxy Formulations*

A new reactive resin proportioning unit has been effective for handling highly filled viscous epoxy formulations. The unit offers interesting possibilities for applications requiring separate metering of fillers in conjunction with resin and hardener. The unit consists of two electrically driven positive displacement pumps for proportioning resin and hardener in correct ratio. These reactive materials are delivered to the mixer-extruder. where they are mixed with the filler material which is independently metered and introduced into the



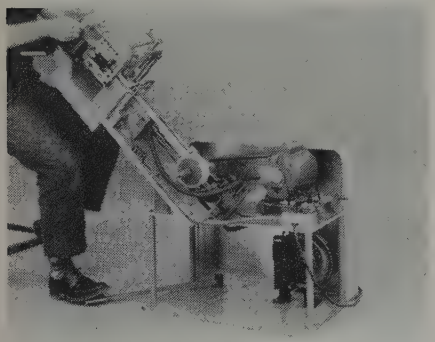
mixer-extruder by a vibratory feed system. The flow rate of the reactive materials and the amount of filler is

adjustable. A rotating screw mixes and extrudes the compound ready for use. The mixer can be set to deliver from 1 to 10 lbs/min. Formulations with high filler ratios reportedly have been successfully compounded and extruded. Advantages claimed over the batch method include: labor saving up to 50%, elimination of pot life problems, and better mixing quality. S. Diehl Mateer Co., 776 W. Lancaster Ave., Wayne, Pa.

***Print No. Ins. 215 on Reader Service Card***

***Pressure-Sensitive Tape-Wrap Machine Wraps 3000 Round Parts Per Hour***

Cylindrical products ranging in diameter from 3/16″ to 11/16″ and in length from ½″ to 1¾″ are automatically wrapped with pressure-sensitive tape in new model A tape-wrapping machine. Design of the feed and discharge sections of the machine permits the handling of products such as tubular capacitors having axial lead-wires. Units are hand-fed and discharge automatically into a receiving tray. Micrometer gages provide for rapid adjustment to accommodate various sizes of products. Operating speed is adjustable while



the machine is running, with a maximum rate of 3,000 pieces per hour. For automatic-feed applications, higher speeds can be provided. Anderson and Hedquist Machine and Tool Co., 1075 N. Tenth St., San Jose 12, Calif.

***Print No. Ins. 216 on Reader Service Card***

---

## *Paper in Electronics*

Specialty papers are still a multi-million dollar market in the electronic industry. They are used with an ever-increasing number of minerals, chemicals and synthetics.

# New Literature

*All catalogs, bulletins, and other literature or sample cards described are available free of charge. To obtain your free copies, just print the item number on the Reader Service Card on the back cover. Fill out and mail the card—no postage is required.* Insulation *immediately forwards your requests to the companies concerned so that the literature can be sent to you.*

### Catalog of Ceramic-to-Metal Terminals and Seals

New catalog of high-temperature alumina ceramic-to-metal insulating terminals and seals covers over 40 standard types of high-alumina terminals which remain high-vacuum-tight during continuous operation at 350°C in air. Terminals are clearly described with photographs, dimensioned drawings, and extensive electrical data tables. Numerous custom-made seals and terminal-to-cover installations are also illustrated and described. 32 pages. Ceramaseal Inc., New Lebanon Center, N. Y.

*Print No. Ins. 301 on Reader Service Card*

### Index and Cross Reference of Electrical Insulating Products

New index and cross reference of manufactured and fabricated electrical insulating materials lists class A, B, F, and H wedges; precision slit insulator coils; custom-made slot insulators; cuffed or crimped paper coils; and fabricated specialties available in a wide range of materials. A material property comparison chart is included. 8 pages. Immanco Inc., 571 West Washington Blvd., Chicago 6.

*Print No. Ins. 302 on Reader Service Card*

### Data Sheets Describe Epoxy Resin Compounds, Encapsulation Procedures

New series of six data sheets (series No. 1000) list the properties of nine epoxy resin potting compounds and describe latest methods of encapsulating and potting critical parts and assemblies. They also detail recommended procedures for chemical and mechanical cleaning of parts to be bonded or potted, techniques for repairing and patching potted or encapsulated parts, and stripping methods to use to salvage expensive components. 18 pages. Bacon Industries Inc., 192 Pleasant St., Watertown 72, Mass.

*Print No. Ins. 303 on Reader Service Card*

### Brochure on Molding of Polycarbonate Resins

Illustrated brochure (CDC-500) discusses injection and compression molding of polycarbonate resins. It details preheating and drying of pellets, cylinder purging, temperatures, cycles, pressures, nozzles, sprues, runners, gates, vents, and inserts. 12 pages. Chemical Materials Dept., General Electric Co., One Plastics Ave., Pittsfield, Mass.

*Print No. Ins. 304 on Reader Service Card*

### Epoxy Resins Comparison Chart

Folder compares 17 epoxy resins, their components, primary uses, handling characteristics, and physical and electrical properties. Material is in easy-to-read comparison chart form. 4 pages. Mitchell-Rand Manufacturing Corp., 51 Murray St., New York 7.

*Print No. Ins. 305 on Reader Service Card*

### Bulletin on Encapsulation with Heat Shrinkable Sleeves

Encapsulation of resistors and capacitors in a heat shrinkable, moisture-tight, insulating sleeve of irradiated polyolefin is described in a new bulletin. The technique, said to be ideally suited for low cost automated production, is covered fully, and electrical and other properties, sizes, and other information are given. Rayclad Tubes Inc., Oakside at Northside, Redwood City, Calif.

*Print No. Ins. 306 on Reader Service Card*

### 1962 Condensed Catalog of Laminated Plastics, Vulcanized Fibre

Engineering data on laminated plastics and vulcanized fibre is given in new 1962 condensed catalog. The data is useful in selecting and apply-

ing these materials in electrical, electronic, and mechanical applications. One 2-page spread lists general data and engineering data for 25 common grades of laminated plastics. The general data give suggested applications, corresponding NEMA grades, military specification, color, and forms and sizes in which furnished. The engineering data includes typical physical, mechanical, and electrical properties. A second spread gives substantially the same type of information for six grades of vulcanized fibre. Special grades of vulcanized fibre are also described. 8 pages. Taylor Fibre Co., Norristown, Pa.

***Print No. Ins. 307 on Reader Service Card***

### *Technical Information on Polyurethane Coated Magnet Wire*

Technical information on polyurethane coated magnet wire, along with physical and electrical property data are contained in new bulletin MW 1003. It also contains easy-to-use summaries of test results that must be obtained for the wire to be judged acceptable according to NEMA No. MW-2-1959 and Mil-W-583B. This is said to be the first time that this specification data ever has been compiled and published in a single reference source. 4 pages. Hudson Wire Co., Magnet Wire Div., Winsted, Conn.

***Print No. Ins. 308 on Reader Service Card***

### *Brochure on Custom Fabrication Of Plastic Electronic Components*

A new brochure describes a firm's capabilities in the custom fabrication of plastic electronic components. It also includes a handy materials guide and design data sheet for outlining application requirements. 6 pages. Emmco Plastics Corp., Everett, Mass.

***Print No. Ins. 309 on Reader Service Card***

### *Catalog of Equipment For Materials Dispensing*

New catalog 42 on air-powered equipment for materials dispensing applications includes pumping systems to dispense compounds, sealers, adhesives, plastic materials, and similar products. Specifications are given on pumps, dispensing accessory units, measuring valves, and airless hydraulic units and accessories. Also

listed are hose, air controls, couplers, nipples and adapters needed for systems. Photos show equipment in use. 32 pages. Lincoln Engineering Co., 4010 Goodfellow Blvd., St. Louis 20, Mo.
*Print No. Ins. 310 on Reader Service Card*

### Brochure on Letter-Numeral Wire Marking Equipment

New brochure on machines and systems for the permanent marking of electrical and electronic wire harnessing is entitled "Simplify Wire Assembly . . . . right in your own plant." It describes machines, marking foils, and special alloy type using a letter-numeral coding system. Kingsley Machine Co., Aircraft/Missile Div., 850 Cahuenga Blvd., Hollywood 38, Calif.
*Print No. Ins. 311 on Reader Service Card*

### Data Sheet on Silicone Mold Release Spray

New data sheet describes advantages of a silicone spray used as a mold release when casting epoxy resin. 2 pages. John C. Dolph Co., Monmouth Junction, N. J.
*Print No. Ins. 312 on Reader Service Card*

### Military Specifications Bulletin

New military specifications bulletin No. 13 is believed to be the only completely separate, up-to-date military specifications bulletin available. It incorporates military specifications for Mil-I-3505-C which covers Insulation Sheet and Tape, Electrical Coil and Slot, High Temperature, released October 18, 1960; and Mil-I-2107A (Ships) covering Insulation Sheet and Tape, Electrical, Reinforced Mica Paper, released July 31, 1959. The Macallen Co. Inc., Newmarket, N. H.
*Print No. Ins. 313 on Reader Service Card*

### Brochure on Electrostatic Generators For Insulation Testing, Other Uses

New brochure describes a line of electrostatic generators used in insulation testing, nuclear physics, electron microscopy, x-ray generation, electrostatic precipitation, etc. Complete specifications for high voltage d-c power supplies are given for models ranging from 50 kv to 600 kv output. Features, applications, and principles of operation are included. A series of schematics illustrates the text. 8 pages. SAMES-USA, 30 Broad St., New York 4.
*Print No. Ins. 314 on Reader Service Card*

### Plastics and Chemical Product Index and Property Data

New bulletin No. P-104 describes industrial and specialty chemicals. Chemical property data and shipping information are listed for acids and anhydrides, alcohols, aromatic intermediates, aldehydes, plasticizers, solvents, and a group of miscellaneous chemical products. The new product index also describes specialty products such as low-molecular-weight polyethylene resins and rubber antiozonants. Eastman Chemical Products Inc., subsidiary of Eastman Kodak Co., Kingsport, Tenn.
*Print No. Ins. 315 on Reader Service Card*

### Heat Resistant Vinylidene Fluoride Resin Data Bulletin

New product bulletin VF2R-61 on heat resistant vinylidene fluoride resin gives electrical and other properties, lists applications, and discusses fabrication. 18 pages. Research Products Development Dept., Technical Div., Pennsalt Chemicals Corp., Box 4388, Philadelphia 18, Pa.
*Print No. Ins. 316 on Reader Service Card*

### Manual on Test Facilities for Cables, Components, and Assemblies

A new manual offers information useful in the design and application of automated test facilities for cables, components, and completed assemblies. Manual R-73 contains data on facilities for determining continuity, resistance, leakage current, and dielectric strength of electrical and electronic devices. Included is data on high voltage d-c power supplies rated to 250 kv at 50 ma, as well as special corona detecting equipment. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.
*Print No. Ins. 317 on Reader Service Card*

### Bulletins on Fluorosilicone Fluids, Greases, and Compounds

New technical bulletins on fluorosilicone fluids, greases, and compounds contain properties and performance charts and graphs and suggested applications for these new solvent fuel, and chemical-resistant materials. They are designated 15-200 for fluids (4 pages), 15-201 for compounds (2 pages), and 15-202 for greases (2 pages). Dow Corning Corp., Midland, Mich.
*Print No. Ins. 318 on Reader Service Card*

### High Voltage Test Sets Catalog Data Sheet

New bulletin on high voltage test sets is part of a general catalog and features a new line of a-c test sets, including the "K" series for testing in accordance with ASTM D149-59T standards. The 3 series covered include 69 different models. All pertinent engineering data and prices for each are given in tabular form. 4 pages. Peschel Electronics Inc., Towners, Patterson, N. Y.

### Brochure on Class H Coated Insulating Materials

Brochure on coated insulating products for class H temperature applications lists typical applications, operating temperatures, thicknesses, and tensile and electrical strengths of silicone rubber coated glass, silicone resin varnish coated glass, and PTFE ("Teflon") coated glass. 4 pages. Dept. W1-515, Irvington Div., Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn.
*Print No. Ins. 319 on Reader Service Card*

### Folder on Ovens, Dryers, and Controlled Atmosphere Stations

New short form catalog folder describes and illustrates a variety of ovens, dryers, and controlled atmosphere stations for research and production. 6 pages. Temperature Engineering Corp., One Temcor Blvd., Riverton, N. J.
*Print No. Ins. 320 on Reader Service Card*

### Booklet Helps Discover and Encourage Future Scientists and Engineers

"Is There a Future Scientist or Engineer in Your Home?" is the title of a booklet offered as a primer to help parents and leaders of young people in the discovery and encouragement of the nation's future scientists and engineers. It also covers such subjects as 1) where to seek specific counsel, 2) possible financial aid for the college-bound youngster, and 3) possibility of a student working his way through college. 32 pages. Write

to Public Service Office, Battelle Memorial Institute, Columbus 1, Ohio.

### Rubber and Latex Manual Gives Battery Cap and Cable Jacket Recipes

Manual HM-8 on rubber and latex includes information on use in making such products as battery caps and cable jackets and on improving the impact resistance of polystyrene. A list of material suppliers with trademark names is also given. 40 pages. B. F. Goodrich Chemical Co., a division of B. F. Goodrich Co., 3135 Euclid Ave., Cleveland 15, Ohio.

*Print No. Ins. 321 on Reader Service Card*

### Bulletin on Nickel Plated Copper Wires

Engineering data on single strand copper conductors electroplated with coatings of pure nickel is contained in new bulletin OW-1002. Normally used under high temperature insulations such as Teflon TFE and ceramic coatings, the nickel plated copper wires are intended for use at continuous temperatures between 250° and 750°. In addition to providing electrical and physical data on ranges of wires with five different standard nickel plating thicknesses, the literature is said to be the first ever prepared that summarizes the five most widely used military and industrial specifications that relate to nickel plated conductors. Ossining Div., Hudson Wire Co., Ossining, N. Y.

*Print No. Ins. 322 on Reader Service Card*

### Bulletin Describes Modular Infrared Split Muffle Oven

A new modular muffle oven that is "split" longitudinally and hinged to provide for easy inserting and removing of work is described in new bulletin 117. The oven offers high speed heating in the curing or heating of insulation on wire and cable, tubing, extrusions, etc. It describes the operation and nine advantages of these ovens over other types of equipment . . . also the flexibility of modular construction. Specifications and a table of sizes are included. Infra–Red Systems Inc., 240 Route 23, Riverdale, N. J.

*Print No. Ins. 323 on Reader Service Card*

### Bulletin Describes Tensile Testers For Leads, Terminals, and Connectors

Bulletin 750/P gives complete specifications for the model "TT" tester, which is specially designed for testing the breaking strength of electrical leads, terminals, and connectors, and for companion model "TJ" tester, which is equipped with two automatic jaw pairs for tensile testing many small parts or material samples as well as electrical leads and connections. It fully describes construction and operation, and the individual components including air motors, specimen holding devices, and accessories. 4 pages. Hunter Spring Co., A Division of American Machine & Metals Inc., Lansdale, Pa.

*Print No. Ins. 324 on Reader Service Card*

### Catalog Sheet on Environmental and Testing for Electronic Components

An illustrated catalog sheet describes a complete commercial environmental and instrument testing facility for fulfilling military and other testing specifications, with special emphasis on electronic components. 2 pages. Ortho Reliability Environmental Laboratories Inc., a subsidiary of Ortho Industries Inc., 7 Paterson St., Paterson 1, N. J.

*Print No. Ins. 325 on Reader Service Card*

### Bulletin Describes X-Ray Inspection Of Cable Terminations and Splices

New bulletin No. 7, entitled "Non-Destructive Inspection of Cable Terminations and Splices by X-Ray Analysis," describes and illustrates in detail the procedures of radiographic inspection employed in examining electrical cable terminations and splices by the use of x-ray. 4 pages. Balteau Electric Corp., 10-14 Meadow St., Stamford, Conn.

*Print No. Ins. 326 on Reader Service Card*

### Metallized Glass Enclosure Tubes Data Sheet

Metallized glass enclosure tubes that can withstand down-shock from 275°C to ice water are described in reference file CE-6.00. The data sheet says the tubes are especially suitable as component enclosures, rectifier tubes, and glass bushings, and that metallizing process makes possible hermetic seals which have a bond strength of 1200 to 1500 psi. Standards and tolerances for outside diameters of the tubes and for the widths of the metallized bands are listed, as well as electrical and physical properties. 2 pages. Corning Electronic Components, Corning Glass Works, Bradford. Pa.

*Print No. Ins. 327 on Reader Service Card*

### Catalog of Standoffs, Spacers, Posts

New catalog lists a complete range of standoffs, spacers, and posts in a wide range of sizes, shapes, and materials. A wide selection of finishes is also listed. Catalog includes pricing formula. Angler Industries Inc., 75 Winthrop St., Newark 4, N. J.

*Print No. Ins. 328 on Reader Service Card*

### Bulletin on Effects of Radiation on Mica

Technical Bulletin No. 2, Effects of Radiation on Mica, contains data indicating that mica, like most other silicate and oxide crystalline minerals, can tolerate higher radiation levels than various organic materials. 2 pages. Mica Industry Association Inc., 420 Lexington Ave., New York 17.

*Print No. Ins. 329 on Reader Service Card*

### Bulletin Describes New Polarizing Principle for Modular Circuit Boards

Technical bulletin (No. 6120) describes new "Polarite" polarizing system for accurate insertion of modular circuit board assemblies in detail, and contains diagrams illustrating the several types of studs and sockets used in its application. Test jacks, switches, printed circuit edge connectors, and other components are also illustrated and described. 4 pages. The Ucinite Co., Division of United-Carr Fastener Corp., Newtonville 60, Mass.

*Print No. Ins. 330 on Reader Service Card*

### Notes From Technical Seminar on High Potential Dielectric Testing

New bulletin 10-15.1, reprint of excerpts from the transcript of a technical seminar held on the West Coast to clarify some of the confusion and disagreement regarding dielectric testing, is titled "High Potential Dielectric Testing." It also illustrates and describes some instruments for testing insulating materials. 8 pages. Associated Research Inc., 3777 W. Belmont Ave., Chicago 18.

*Print No. Ins. 331 on Reader Service Card*

### Bulletin on Portable High Current Test Sets

New bulletin SB-361 describes and illustrates a series of portable test sets for use in testing current, voltage, or thermally actuated devices which are used to prevent electrical overload, short circuits, motor failures, and electrical fires. 4 pages. Multi-Amp Electronic Corp., 465 Lehigh Ave., Union, N. J.

*Print No. Ins. 332 on Reader Service Card*

### Molded Connector Data Sheets

Electrical and physical information on molded pin power connectors, series RP and MP, is given in engineering data sheets. Also included are a series of dimensional drawings and a review of the materials used in the series which meet applicable paragraphs of Mil-C-8384 and Mil-C-5015. 2 pages. Lionel Electronic Laboratories, Division of The Lionel Corp., 1226 Flushing Ave., Brooklyn 37, N. Y.

*Print No. Ins. 333 on Reader Service Card*

### Catalog of Wire, Cable, Tubing, and Electronic Hardware

Comprehensive new catalog gives engineering and purchasing specifications for a complete line of wire, cable, tubing, electronic hardware and switches, and radio and TV accessories and components. Prices and government and industrial specifications are included. 52 pages. Birnbach Radio Co., Inc., 145 Hudson St., New York 13.

*Print No. Ins. 334 on Reader Service Card*

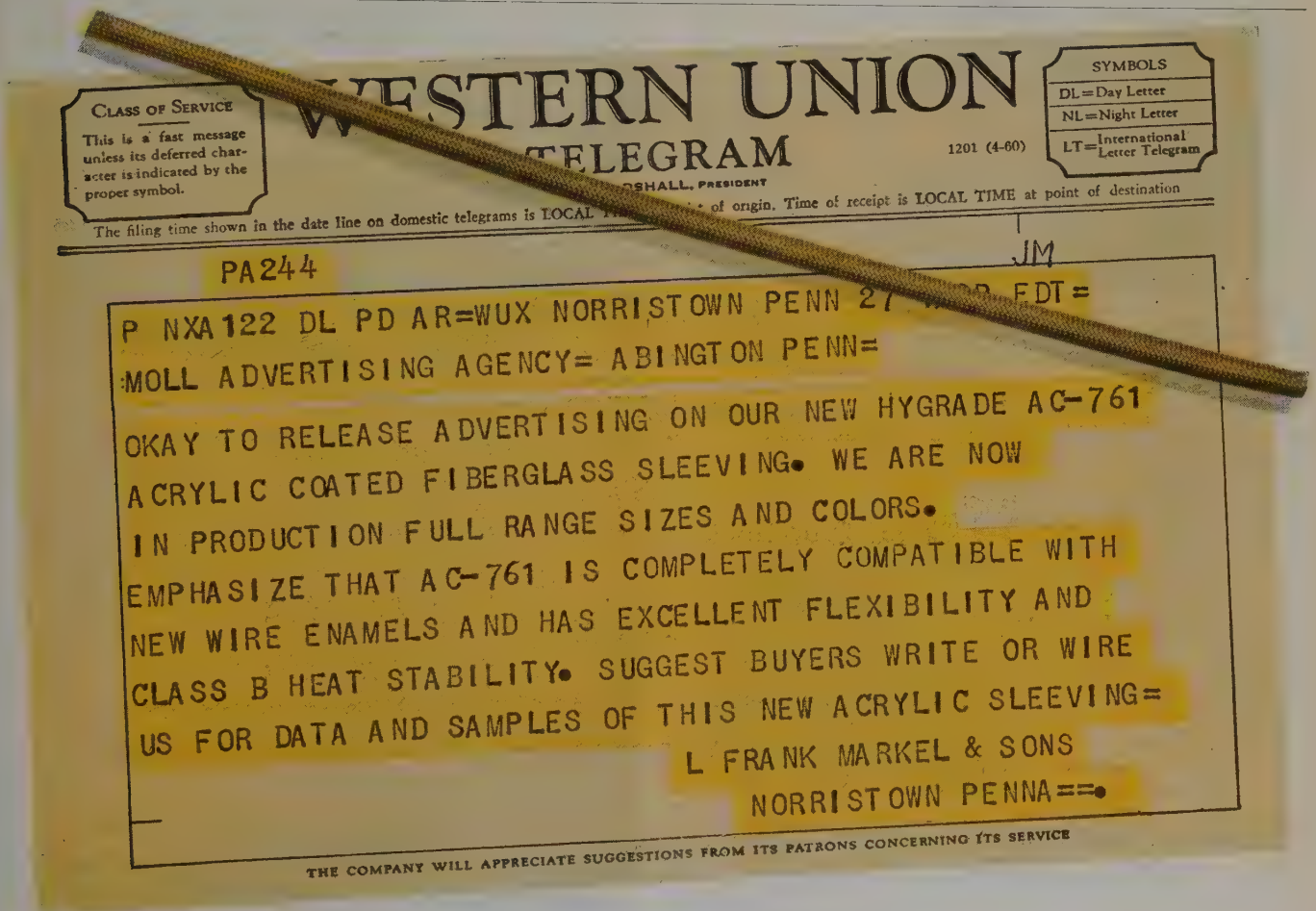
### Plastics Education Brochure

New brochure, "Engineering Education in Plastics," includes a comprehensive discussion of the desirability of specialized training to prepare an engineering student for a career in plastics as well as a description of recommended courses to provide such a training. 12 pages. Society of Plastics Engineers, 65 Prospect St., Stamford, Conn.

*Print No. Ins. 335 on Reader Service Card*

### Catalog on Polystyrenes

Detailed technical bulletin, S-61,




*Print Ins. 40 on Reader Service Card*

describes a line of all-purpose polystyrenes, covering general purpose grades as well as modified impacts. In addition to a general description of each grade, it gives mechanical, physical, optical, thermal, and electrical properties of each. Solar Chemical Corp., Solar Park, Leominster, Mass.

*Print No. Ins. 336 on Reader Service Card*

***Brochure on Vacuum Metallizing For Capacitors, Resistors***

New and comprehensive bulletin 584 discusses advantages of the vacuum metallizing process over other metal-deposition techniques, illustrates a large number of current applications (such as metallizing dielectrics for capacitors and resistors), gives suggestions on lacquering and filament arrangement, and lists complete specifications for latest equipment designs. 16 pages. F. J. Stokes Corp., 5500 Tabor Road, Philadelphia 20, Pa.

*Print No. Ins. 337 on Reader Service Card*

***Bulletin on Leak Detectors for Pressure and Vacuum Systems***

Bulletin GEA-6817A describes Type H line of portable, halogen sensitive, electronic leak detectors for pressure and vacuum systems. They include a helium-sensitive mass spectrometer leak detector for ultra-sensitive applications in electronics, nuclear, aircraft, and missile industries. Information on operation, specifications, features, accessories, ordering, and how to select proper percent of tracer gas and test pressures is given. 8 pages. Instrument Dept., General Electric Co., West Lynn, Mass.

*Print No. Ins. 338 on Reader Service Card*

***Miniature Connector Catalog***

A quick reference product bulletin (MA-101) gives information, including physical and electrical properties, insert arrangements, and termination and assembly procedures, for Mil-C-26500-A miniature electrical connectors. 6 pages. The Pyle-National Co., 1334 N. Kostner Ave., Chicago 51.

*Print No. Ins. 339 on Reader Service Card*

***Technical Information Bulletin On Silver Plated Copper Wire***

A new technical information bulletin on single end silver plated copper conductors gives details on properties of SPC in wide OD ranges and seven standard plating thicknesses, and also discusses copper base metals normally used. It is the only reference published that summarizes the seven most widely used military and industry specifications for silver plated copper conductors. Ossining Div., Hudson Wire Co., Ossining, N.Y.

*Print No. Ins. 340 on Reader Service Card*

***Folder and Data Sheets on Three Multiple-Connector Lines***

New folder describing three lines of multiple connectors contains data sheets for each of the lines. The data sheets give complete specifications on contact sizes and materials, wire crimp and insulation support, wire and insulation size ranges, receptacles, and housings. Also described is a compression-crimp technique, and the tooling, both hand and automatic, for attaching terminals to circuit leads and for stripping wire preparatory to crimping. 12 pages. AMP Inc., Eisenhower Blvd., Harrisburg, Pa.

*Print No. Ins. 341 on Reader Service Card*

*Canadian National Telecommunications uses No. 6 ACSR wire (Aluminum Conductor Steel Reinforced Wire). This wire is sheathed in Hi-fax only 0.031 inches thick.*

# HI-FAX®

## keeps communications lines in service longer

To minimize "cross talk" or other interference, Canadian National Telecommunications transposes its lines through special brackets. High winds rubbing wires against bracket insulators tend to wear low-density insulation on the conductors.

By using high-density polyethylene coating for communications wire on some of their circuits, CNT got a wire insulating sheath with better mechanical properties and superior abrasion resistance. Line maintenance reduction and customer service improvement are anticipated.

Hi-fax was the first high-density polyethylene used to coat wire and cable. Its high molecular weight and excellent combination of properties continue to rate first place for applications where abrasion, cut-through, and heat crack resistance are a must.

Hi-fax is the only high-density polyethylene specifically designed for extrusion. It provides wire-coating speed, gauge tolerances, and freedom from pinholing that help produce better insulated wire at low cost. Write or call Hercules for further information.

HERCULES POWDER COMPANY
INCORPORATED

QP61-10

POLYMERS DEPARTMENT • HERCULES TOWER, 910 MARKET STREET, WILMINGTON 99, DELAWARE

**Print Ins. 62 on Reader Service Card**

# *Dates to Circle*

## *Meeting and Convention Notices*

Dec. 1 . . . SPE, Plastics Screw Injection Molding, Retec sponsored by Cleveland Section, Cleveland Engineering Society Building, Cleveland, Ohio.

Dec. 12-14 . . . Eastern Joint Computer Conference, sponsored by AIEE, IRE, and Association of Computer Manufacturers, Sheraton-Park Hotel, Washington, D.C.

Jan. 9-11 . . . Eighth National Symposium on Reliability and Quality Control, sponsored by IRE, EIA, AIEE, and American Society for Quality Control, Statler Hilton Hotel, Washington, D. C.

Jan. 29-Feb. 2 . . . AIEE, Winter General Meeting and First National Electrical Engineering Exposition, Hotel Statler and the Coliseum, New York City.

Jan. 30-Feb. 2 . . . SPE, 18th Annual Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

Feb. 5 . . . Committee Week, Committee D-27 on Electrical Insulation Liquids and Gases, ASTM, Statler Hilton Hotel, Dallas, Texas.

Feb. 6-8 . . . SPI, 17th Reinforced Plastics Division Conference, Edgewater Beach Hotel, Chicago.

Feb. 7-9 . . . IRE, Third Winter Convention on Military Electronics, Ambassador Hotel, Los Angeles, Calif.

Feb. 11-17 . . . National Electrical week, National Electrical Week Committee, 290 Madison Ave., New York 17.

Feb. 14-16 . . . International Solid-State Circuits Conference, AIEE, IRE, and Univ. of Pennsylvania, University Campus and Sheraton Hotel, Philadelphia, Pa.

Feb. 19-22 . . . Fourth Electrical Insulation Conference and Exhibition, Shoreham Hotel, Washington, D.C.

Mar. 14-16 . . . ASTM, Committee D-27, Spring Meeting, Motor House, Williamsburg, Va.

Mar. 19-21 . . . Second National Electric Comfort Heating Exposition and Symposium, NEMA, Hotel Sherman, Chicago.

Mar. 20-29 . . . American Chemical Society, 141st National Meeting, Washington, D.C.

Apr. 2-7 . . . Annual Conference, Western Section of SPI, Del Coronado Hotel, Coronado, Calif.

Apr. 4-6 . . . AIEE, South Central District Meeting, Hotel Peabody, Memphis, Tenn.

Apr. 9-10 . . . Rubber and Plastics Industries Conference, Sheraton Hotel, Akron, Ohio.

Apr. 9-13 . . . American Welding Society, Sheraton Cleveland Hotel and Cleveland Public Auditorium, Cleveland, Ohio.

Apr. 17 . . . SPE Retec, Polypropylene's Expanding Position in Plastics, Sheraton Hotel, Philadelphia, Pa.

Apr. 18-20 . . . AIEE, Great Lakes District Meeting, Hotel Van Orman, Fort Wayne, Ind.

Apr. 25-29 . . . Western Space Age Industries and Engineering Exposition, Cow Place, San Francisco.

Apr. 30-May 2 . . . AIEE, Mid-America District Meeting, Hotel Chase, St. Louis, Mo.

May 6-10 . . . Electrochemical Society Annual Meeting, Statler Hilton Hotel, Los Angeles.

May 7-9 . . . AIEE, Middle Eastern District Meeting, Hotel Du Pont, Wilmington, Del.

May 8-10 . . . Electronic Components Conference, sponsored by AIEE, EIA, and IRE, with American Society for Quality Control and Society for Nondestructive Testing participating, Marriott Twin Bridges Motor Hotel, Washington, D. C.

May 9-11 . . . AIEE, North Eastern District Meeting, Hotel Statler, Boston, Mass.

May 10-11 . . . SPE, Workshop on Encapsulation: Materials and Techniques, Newark, N. J.

May 14-16 . . . AIEE-IRE, Joint District Meeting, Erie, Pa.

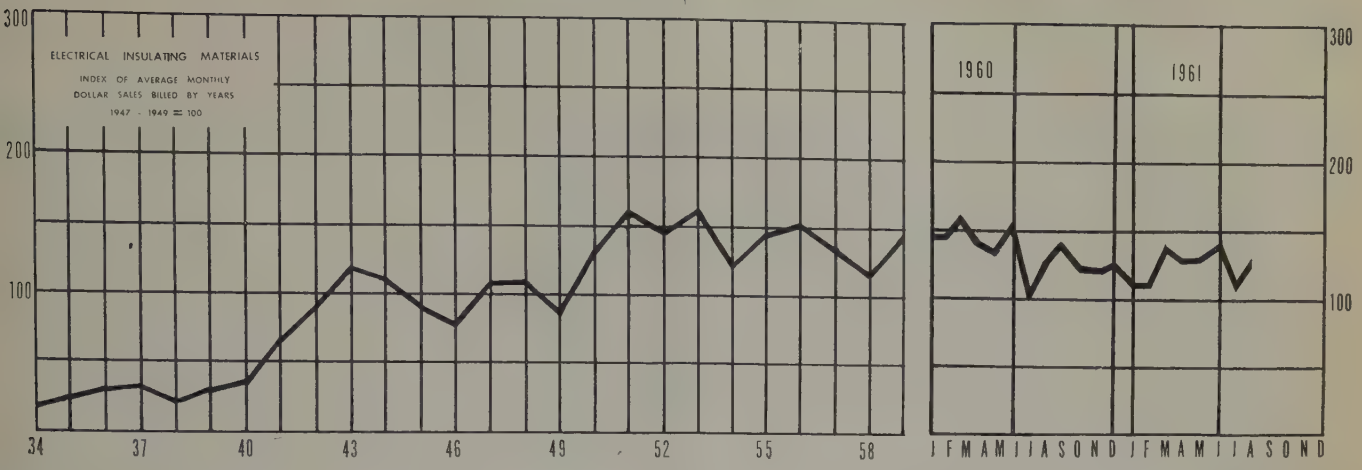
May 23-25 . . . AIEE-ISA-ARS-IAS, National Telemetering Conference, Sheraton-Park Hotel, Washington, D.C.

May 28-29 . . . SPI, 20th Canadian Section Conference, Chateau Frontenac, Quebec City, Canada.

### Abbreviations Used in Notices

| | | | |
|---|---|---|---|
| AIEE | —American Institute of Electrical Engineers | NEMA | —National Electrical Manufacturers Assn. |
| ASTM | —American Society for Testing and Materials | EASA | —Electrical Apparatus Service Assn. |
| ASME | —American Society of Mechanical Engineers | SPE | —Society of Plastics Engineers |
| ASA | —American Standards Assn. | SPI | —Society of the Plastics Industry |
| IRE | —Institute of Radio Engineers | WEMA | —Western Electronic Manufacturers Assn. |
| EIA | —Electronics Industries Assn. | | |

# *NEMA Electrical Insulation Index*




| | Aug. '61 | July '61 | Aug. '60 |
|---|---|---|---|
| Index Series | 135 | 105 | 131 |
| Aug. '61 point change from other mos. | +30 | | +4 |
| Aug. '61 % change from other months | +28 | | +3 |

*Index is based on 1947-1949 average month, inclusive= 100*

*Published through the courtesy of the National Electrical Manufacturers Association*

***Materials Used in Electrical Insulation Index***

Industrial Laminated Products

Manufactured Electrical Mica

Flexible Electrical Insulation

Vulcanized Fibre

Coated Electrical Sleeving

# Advertisers' Index

*To obtain more information on products of* Insulation *advertisers, just print the advertisement number shown for each advertiser in one of the spaces on the Reader Service Inquiry Card on the inside back cover. This number appears under each advertisement and is also repeated in the listing below. After filling out the card completely, tear it off and drop it in the mail—no postage required.* Insulation *will promptly forward your requests for further information to the advertisers.*



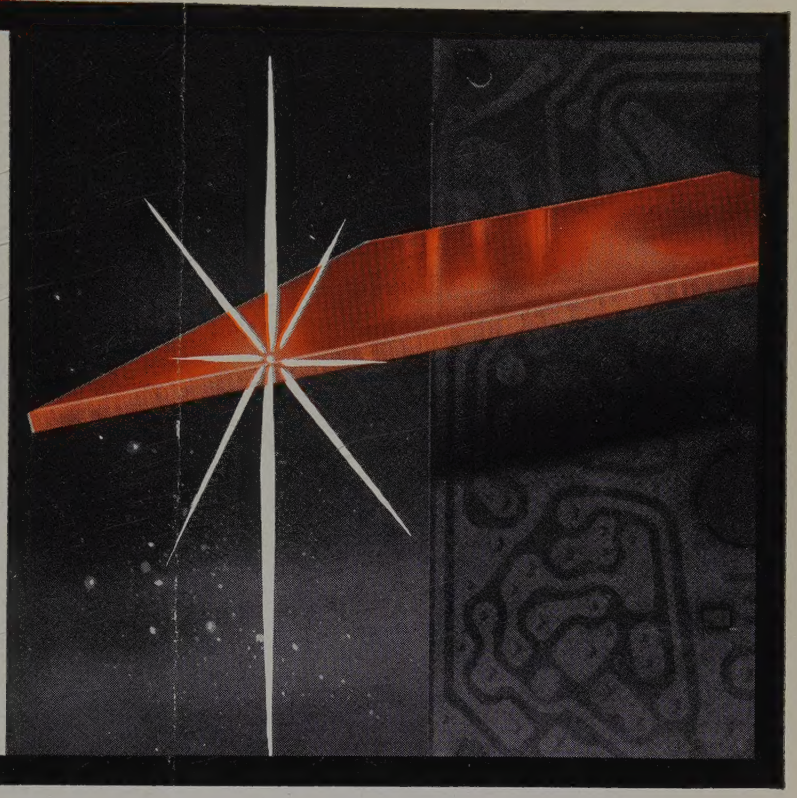


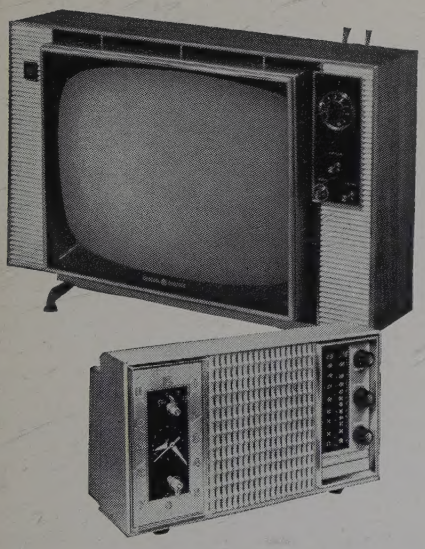

*Advertising Sales Offices:*
*Libertyville, Ill.*—(General Offices P.O. Box 270, 311 E. Park Ave. Phone EMpire 2-8711 (Area Code 312)
*Chicago 11, Ill.*—Philip Holmes, Robert D. Foran, and Tom Fitzpatrick. 410 N. Michigan Ave. Phone 467-6240
*Detroit 26, Mich.*—Charles R. Schroeder 413 Lafayette Bldg. Phone WOodward 1-0278
*New York 20, N.Y.*—Robert Bandini and Roland Robitaille 1 Rockefeller Plaza. Phone CIrcle 6-4712
*Pacific Coast*—H. L. Mitchell & Assoc., 1450 Lorain Road. San Marino, Calif. Phone CUmberland 3-4394
Northern California only—James T. Stevenson, 420 Market St., San Francisco 11, Calif. Phone YUkon 1-3575

# Textolite®/reliability

## Textolite® 11571

# RADIO and TELEVISION'S newest STAR

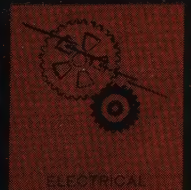




The General Electric TV Receiver Department is one of the major manufacturers of television sets sold in the United States. Contributing to this high volume has been the quality achieved through rigid manufacturing procedures. Part of the strict specifications call for Textolite 11571 XXX PC Copper-Clad laminate for use as circuit boards in all of their TV home receivers.

According to a TV Department spokesman, 11571 was selected because of its excellent insulation resistance under humid conditions. It has superior punching characteristics, stands up well in soldering and has good peel strength. Mr. W. W. Ward, Supervisor, Components, TV Receiver Department, said, "Since changing to 11571, production quality has been materially improved. It is the best laminate we've ever used."

Especially designed for use in television and radio receivers, G-E Textolite 11571 reliably meets UL testing standards, MIL-P 13949B and MIL-P 3115, type PBE-P specifications as well as NEMA XXX PC requirements. If you manufacture TV or radio equipment, you probably have an application in which 11571 would assure added reliability at a low cost. We will be happy to supply you complete information and samples. Write: Laminated Products Department, Section I-121, General Electric Co., Coshocton, Ohio.




*Progress Is Our Most Important Product*

GENERAL ELECTRIC

***Print Ins. 48 on Reader Service Card***

**WHERE RELIABILITY COUNTS**

# BEN HAR 1151

## EXPANDABLE SLEEVING

At **WESTINGHOUSE** the use of BEN HAR 1151 has resulted in significant cost and time savings in the production of their luminaire lighting equipment (Street Lighting Luminaire #OV-25). The inherent toughness of BEN HAR 1151, an extrusion coated expandable fiberglass silicone rubber sleeving, has reduced rejections, given improved transformer lead protection and reduced the sizes of the sleeving required. (This size reduction resulted in a 28% savings in material alone.) Dielectric protection remains excellent.

BENTLEY-HARRIS

MANUFACTURING CO.

CONSHOHOCKEN PENNSYLVANIA

***Print Ins. 50 on Reader Service Card***